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ELECTRIC HEATING OF BUILDINGS.

Elsewhere in this issue will be found a brief description of an installation for the electrical heating of a building in Twin Falls, Idaho, which is used for offices and stores, and contains in addition a dancing hall. This is probably the largest building to which the electrical method of heating has yet been applied, and it is notable as being in a latitude in which heating is required for eight months in the year. The contract under which current is supplied permits the use of the entire connected load for that period. The great advantages of electric heating hardly need be enumerated. The entire absence of dirt and the care of a furnace, which are always inherent in the heating from a local furnace, whether it be for hot air, hot water or steam, are two very important points. The time and labor connected with taking care of a furnace and removing the ashes are an important element in the cost, especially for a large building. The cleanliness secured by avoiding the hauling of coal and ashes is a vital point. While all the above advantages are secured by either steam or hot-water heating from a central station, neither of the latter give the simplicity and rapidity of control which is inherent in the electric heater. With either steam or hot-water radiators it is impossible to cut off the radiation as quickly as may be done by pulling the switch controlling the supply to an electric heater, and on the other hand, under neither of those systems can the normal rate of radiation be started up so quickly. Furthermore, by means of a control switch governing the connection of the heating units to the mains, the supply of a moderate quantity of heat is much more easily and definitely adjusted than is possible with a steam radiator.

Twin Falls is exceptionally well situated to obtain electric power at a low rate, which makes it commercially feasible to apply the electric method of heating, and it is, therefore, not surprising that Twin Falls has taken the lead over all the large cities of the country in this application of electric power. Proximity to the many high falls on the Snake River has enabled hydroelectric plants to be constructed at a minimum cost per kilowatt, and in addition to the low cost of generating power, the great constancy of this kind of a load for a large portion of the year adds to the practicability of offering a minimum rate. There are already a large number of heating installations in Twin Falls, and that city claims to have the largest heating load of any in the world.

Heretofore electric heating has been little applied

aside from railway cars, and it is a notable achievement that it is being so extensively used in any place for buildings.

CENTRAL-STATION POWER CONTRACTS.

The increasing centralization of electric power generation and the rapidly extending practice among small lighting and motor-service companies of enlarging their distributive instead of their productive functions emphasize the importance of central-station power contracts from the engineering standpoint. The manager of a central station supplying one or more small towns or even a city of a few thousand inhabitants is pretty certain before many years to be obliged to face the problem of purchasing electrical energy from a larger and more efficient plant, provided he is located within striking distance of a distinctly metropolitan community. The decision will naturally depend upon terms and conditions prevailing at the time; but assuming that the plan of purchasing energy seems expedient, it is worth finding out what are some of the important engineering features of any desirable agreement between buyer and seller of wholesale current.

The legal features of any power contract may properly be passed upon by counsel, and do not concern the central-station manager, roughly speaking, so directly as the technical phases of the agreement. The industry is best served when a contract presenting the maximum fairness to both parties is drawn for signature, and for this reason some of the points covered in a recent power agreement between two central stations under common control are particularly suggestive. In the case in point, one company supplies the organization in a neighboring town with electricity, the former having a large and economical station of modern design, while the latter until recently operated a plant of very small capacity and inferior economy. A careful study of the situation disclosed the financial desirability of shutting down the small plant and utilizing the cheaper power of the larger station throughout the entire field, there being no possibility of improving the operating efficiency of the smaller station through an enlargement of its capacity enough to offset the greater economy of the larger station and transmission system. The managers of the two companies therefore entered into a power contract after many weeks of work along the lines of securing an instrument which would be of the utmost benefit to each party, and the agreement was further submitted to a disinterested electrical expert for final approval.

The agreement covers fourteen principal items bearing upon the use of current anticipated, the point of delivery, character of current and voltage requirements, measurement of demand and power consumption, provision for tests, increases and deductions due to changes in the price of fuel, billing arrangements, capacity reservations, price agreed upon, arbitration and other points concerned more directly with the life of the contract. Without going into these in detail mention may be made of certain features of special interest, notably the coal-allowance clause agreed upon, and the arrangements made for measurement of energy by the receiving party. On account of fluctuations anticipated in the cost of fuel at the larger station, an inland plant served by rail only, it is provided that if during any consecutive twelve months the average price paid by the larger company for coal of at least 14,500 British thermal units (dry basis) is more than $4.50 per gross ton delivered in the coal pockets of the company, then for each one per cent increase in price of coal and until the average price falls to $4.50 the purchaser agrees to pay the wholesaler of energy 0.007 cent per kilowatt-hour, a similar reduction being given to the purchaser in case the price of fuel drops below $4.25 per ton. The energy sold is measured at the purchaser's station by watt-hour meters, curve-drawing instruments also being placed in service to give the total demand at all times, the unit of demand being defined as one kilovolt-ampere sustained continuously for 15 minutes. The receiving company owns all the line and switchboard equipment within its territory, and upon 48 hours' notice either party has the right to have the measuring instruments tested and, if necessary, recalibrated. Other points of interest are the careful specification of the amount of energy involved and the price to be paid month by month for service; access of meters to the selling company and of coal vouchers to the purchasing station; allowances in case instruments fail to register and means of securing additional power and extending the contract.

The above points are cited as of interest in a carefully analyzed specific case, and might, of course, be set aside in part under other conditions. We doubt if it is usual to include a sliding scale of charges based upon the cost of fuel; but the scheme is an interesting one under present industrial conditions, and the general list of points covered in the syndicated contract cited cannot safely be overlooked by the manager of the central station considering the purchase of electricity on a considerable scale. It may be sufficient to take up these points seriatim and eliminate them in more or less degree from the local papers involved. Failure to give them consideration is the thing to avoid on the part of a progressive management.

WIRELESS RELIEF IN MARINE DISASTERS.

An appalling marine disaster has shocked the world this week. The steamship *Titanic*, the largest and most luxurious ocean greyhound ever built, struck an iceberg and sank into the depths of the North Atlantic on its first ocean trip. At the time this is written, just before going to press, the exact particulars are as yet unknown, but the indications seem to be that a fearful loss of life occurred, over half of the human cargo being unaccounted for, among them being many men of world-wide prominence.

A significant fact stands out from this catastrophe. But for the wireless telegraph the number of survivors might have been greatly reduced or the terrible fate of the steamer even never have been known.

Until about a dozen years ago the range of distress signals was limited to the zone of sound and sight. Many a good vessel has left its port and disappeared without even as much as a crumb of news ever reaching its destination. Now practically every large passenger steamer is equipped with this valuable safeguard, and in most countries the equipment is required by law. The disaster to the *Republic* a few years ago emphasized the need.

This catastrophe serves to focus attention once more upon the great services which electrical science and the electrical industry are rendering to mankind. Not only does this agent aid in our daily work through the use of electric power, and transmit intelligence without delay by means of the telegraph and telephone, but the application of Hertzian electromagnetic waves in such cases of shipwreck is instrumental in saving hundreds of lives.

THE DOMESTIC USE OF ELECTRICITY.

A recent meeting of the Institution of Electrical Engineers in England was devoted to a discussion of the question of causes preventing the more general use of electricity for domestic purposes. The object of this discussion was to call attention to the obstacles which stand in the way of increasing the output of the supply stations and of devising means for combating these.

The discussion made it quite evident that electrical advertising in England is not receiving the attention given to it in this country and that electrical development is being retarded by the neglect of this opportunity. There was also a general expression of the difficulty raised by the high first cost of the electrical apparatus and of the cost of wiring houses for supply.

In connection with the use of electric current for cooking and heating it was made evident that the supply of power at a very low rate was essential to the widespread use of current for these purposes. In many cases in England a special rate is made for current for cooking and this application has made considerable headway, as pointed out in our issue of April 6. In connection with this matter, however, one point raised in the discussion is deserving of considerable attention. In residences where coal fires are not used for cooking, it is necessary to supply some other means for heating water for household purposes, at least during the summer months. Where gas is used for cooking it is customary to supply a gas heater for the purpose. This is available in two forms, one in which burning of the gas is automatically controlled so that hot water can be drawn from the faucet at any time, and the other in which the gas must be lighted whenever a supply of hot water is wanted. If electric cooking is adopted, a supply of gas will still be necessary for heating water unless an electrical method is installed for this purpose also. Here again it is possible to use either an intermittent heater or to have a steady consumption of electric power combined with a storage reservoir. A scheme for carrying out the latter was mentioned in our issue of October 28, 1911, in connection with a description of the Stanley storage range. In that article it was estimated that an ordinary family of five persons would require a steady supply of about 400 watts for the purpose of heating the water. At a rate of one cent per kilowatt-hour this represents a cost of $35 per year, which by most householders would be considered prohibitive. It will thus be evident that the problem of supplying hot water in households using electric current for cooking and lighting is one that has not yet been satisfactorily solved.

CENTRAL-STATION COMMERCIAL RECORDS.

Central-station managers have striven to standardize their plant, distributing systems, metering systems, bookkeeping methods, and systems of accounts, but it has only been within recent months that a few of the more progressive companies have made any effort to systematize the keeping of new-business records. Of course nearly every central station has adopted some systematic method of keeping prospects classified, usually a card-index system, but this is, in the majority of cases, the extent to which records are kept.

For residence and commercial-lighting customers the problem of new-business records is comparatively simple. A card index containing the customer's name, address, business, number of lamps installed—interior, show-window, sign, etc.—heating appliances, etc., with dates and data for future calls would suffice. In connection with the last two items, it is well to point out that this feature is equally as important with old customers as with prospective new ones.

The keeping of power records entails more work, but the importance of such records cannot be too strongly emphasized. Data on every power installation should be compiled and entered in a suitable file. Information should be obtained, for each installation, as to the number of motors, aggregate horsepower, size, type and speed of each motor and the machine or machines which it operates, maximum demand of the installation, load-factor, monthly kilowatt-hour consumption and monthly bill. Supplementing this the construction or engineering department should be required to prepare for the commercial department a diagramatic layout of each plant in which it makes a motor installation, such drawings to be filed with the power records mentioned above.

It is obvious that with this data at hand the commercial department will be enabled to keep closely in touch with its customers and always be in a position to adjust complaints promptly and satisfactorily; or make additions or improvements to an existing installation without loss of time or inconvenience to customers. Also, power solicitors will have data available with which to meet any similar propositions that may arise within their province.

Smoke Abatement in Chicago.

An outline of the plan of work of the Committee on Smoke Abatement and Electrification of The Chicago Association of Commerce, was approved by the Committee at a meeting on April 12, the outline summarizing what has been accomplished during the past year and indicating the lines to be followed during the present year.

Investigation is being made with respect to two zones, one embracing an area of 194.5 square miles, coincident with the city of Chicago; the other covers an area of 234.5 square miles, extending to Waukegan on the north, La Grange on the west, Harvey on the south and Gary on the east. A further extension of this larger zone is considered in the case of certain roads to limits dictated by operating and economic conditions.

The investigation covers a determination of the following subjects: (1) The necessity of changing motive power of steam roads to electric or other power. (2) The mechanical feasibility of such change. (3) The financial practicability of such change.

Necessity of Change.—The study of this subject is well advanced. It comprises obtaining all possible scientific information about existing conditions under coal consumption for the purpose of comparison with the conditions which obtain under electric operation upon such points as: (*a*) Safety. (*b*) Health. (*c*) Comfort and convenience. (*d*) Loss and damage to property.

Another phase of this inquiry is the study of methods of smoke abatement to see how far these are successful in remedying the conditions which argue for a change in motive power. Among the subjects in this direction being studied are: (*a*) Effect of smoke upon property. (*b*) General regulation for smoke abatement. (*c*) Improved methods of smoke abatement. (*d*) Results obtained from smoke abatement.

Classification of the various kinds of smoke producers and determination of the coal consumed and smoke produced by each is a very detailed division of the Committee's schedule.

The Committee's studies will not be confined to present conditions alone but will have a view to future conditions. To this end estimates of the city's growth, the probable changes in the physical arrangements of the Chicago terminal system and the probable amount and distribution of the smoke of the several classes of smoke producers at the end of the year 1917, will be made.

Another feature of the Committee's outlined study is that of the air pollution of large cities and its abatement. Among the forms of air pollution to be investigated are visible smoke, other products of combustion, dust, fumes of chemical, metallurgical, incinerating and rendering processes, products of organic decomposition, micro-organisms.

Mechanical Feasibility of Change.—As a means of reducing air pollution, with respect to railway operation, the following alternative forms of motive-power operation, as compared with steam locomotive operation, will be studied: internal-combustion locomotives, compressed-air locomotives, storage-battery electric motive power, continuous-contact electric motive power.

The investigation includes a study of existing physical characteristics of Chicago terminals as related to the mechanical feasibility of a change in motive power, the relation of existing routes and traffic movements and also the probable conditions that will exist in the year 1917.

Public Utilities Inquiry.

The Department of Regulation of Interstate and Municipal Utilities of the National Civic Federation has decided to institute an investigation designed to determine how far regulation of public utilities may go without interfering unduly with management. At a meeting of the Executive Council on April 13 it was announced that John H. Gray, professor of economics at the University of Minnesota, will have charge of this investigation. He will be assisted by William D. Kerr, formerly of the Wisconsin Railroad Commission, and others. All state and national public-utility laws will be compiled and a study will be made of sliding-scale and profit-sharing schemes in Europe.

The various sub-committees with chairmen are as follows: Rates, Franklin K. Lane; Control of Service, Martin S. Decker; Control of Capitalization, Milo R. Maltbie; Franchises, Blewett Lee; Accounts and Reports, Leo S. Rowe; Ways and Means, Franklin Q. Brown. The chairman of the department is Emerson McMillin.

Taxation and Regulation in Kentucky.

Public-utility companies all over Kentucky are much disturbed over the announcement of the State Board of Valuations and Assessments that it intends to increase all franchise assessments, carrying out its announcement by mailing increases amounting to $137,000,000 in the first lot of assessments considered. The corporations affected will in all probability appeal to the State Board of Equalization. It is also reported that Gov. McCreary, of Kentucky, plans to call a special session of the Legislature to consider the passage of a bill creating a public-service commission, the regular session failing to take action.

Program for Pittsburgh Meeting.

At the joint meeting of the Association of Iron and Steel Electrical Engineers and the American Institute of Electrical Engineers, which will be held in Pittsburgh, Pa., April 25 to 27, the following papers will be read: "The Electrical Construction of a Large Mine Hoist," by H. W. Cheney; "The Use of Alternating Current in Unloading Coal," by W. N. Ryerson and J. B. Crane; "Electrification of a Reversing Mill of the Algoma Steel Company," by Bradley T. McCormick; "Self-Starting Synchronous Motors," by C. J. Fechheimer; "Does it Pay the Average Coal Mine to Purchase Central-Station Power?" by G. Bright; "Direct-Current and Alternating-Current Mill Motors for Auxiliary Drives," by Brent Wiley; "Advantages of Automatic Control in Steel-Mill Operation," by Stewart C. Coey; "Operation of a Large Electrically Driven Reversing Mill," by W. Sykes; "The Electrical Braking of Induction Motors," by H. C. Specht; "Motor-Driven Reversing Mill at American Sheet and Tin Plate Company," by J. E. Smith; "Application of Motors to Large Valves and the Method of Controlling Them," by H. M. Gossman.

This program has been arranged by the Industrial Power Committee of the American Institute. The meeting is to be held under the auspices of this Committee and of the Pittsburgh Section. The Fort Pitt Hotel has been selected as headquarters for the meeting and the technical sessions will be held there. A number of trips to industrial plants in and around Pittsburgh have been arranged, including steel works, gas works, Westinghouse Electric & Manufacturing Company, and probably coal mines. To facilitate these visits it is proposed to hold sessions for the reading of papers on Thursday and Friday evenings.

Officials of Railway Association Start on Long Trip.

A number of officials of the American Electrical Railway Association have started on a tour of the country for the purpose of looking into electric-railway systems and studying the attitude of the public towards public utilities. A private car containing the party left New York City at 9:30 p. m. on April 17. The itinerary of the trip includes Richmond, Charleston and several cities in Georgia, Alabama and Tennessee. From New Orleans the party will proceed through Texas to Oklahoma City and then to Southern California, following the Pacific Coast up to Vancouver. The return trip will include Seattle, Spokane, Minnesota, Omaha, St. Louis, Louisville, Indianapolis, Southern Illinois, Cincinnati and Pittsburgh.

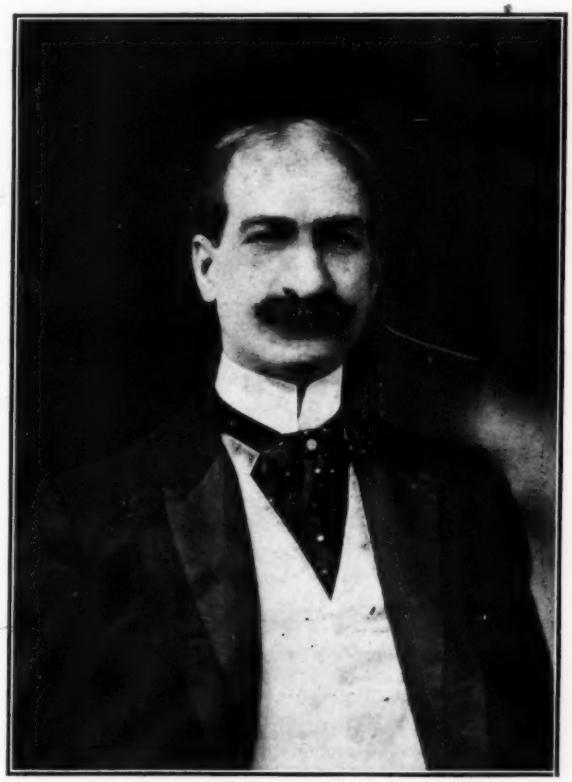
Henry Floy.

Henry Floy, consulting engineer, has, on a number of occasions, been identified with some of the most conspicuous engineering developments of the last twenty years.

Mr. Floy was born at Elizabeth, N. J., September 19, 1866, the son of James and Sarah A. Floy. He received his degree of A. B. at Wesleyan University, in 1889, and the degree of A. M. in 1892. He received his mechanical engineer degree from Cornell University in 1891. Shortly after leaving college he engaged as a consulting engineer with headquarters in New York, and early in his practice achieved special reputation as an electrical engineer in connection with hydraulic and high - tension - transmission work. He organized and became president of the Henry Floy Company. In the famous Colorado Springs lighting controversy in 1906 and 1907, he was a member of the Board of Arbitration in company with Prof. L. G. Carpenter of the Colorado State Agricultural College, and E. L. Elliott, editor of the *Illuminating Engineer*, New York. The street-lighting controversy between the City of Colorado Springs, Colo., and the Pikes Peak Hydroelectric Company, arose over the interpretation of a clause in a city ordinance. The important character of the question stated, the permanent value of the opinions of the expert called, the data established as to a fair and sensible method of settling an engineering controversy, and the repeated requests for statements of the exact points involved, seemed to demand that the history of the case should be put in book form. Mr. Floy performed, in connection with this case, a great service to engineering and to the literature of the law concerning the points involved, by editing and publishing, in 1908, a compilation of the records, with an introduction and epitomization of the salient points.

In August, 1909, Mr. Floy was retained by Bion J. Arnold in direct charge of the appraisal of the street railways of Greater New York and the elevated railways in Brooklyn, which Mr. Arnold prepared for the Public Service Commission of the First District of the State of New York. At the convention of the American Institute of Electrical Engineers at Chicago, July, 1911, Mr. Floy presented one of the most complete and far-reaching discussions of the subject of the depreciation of electrical and mechanical apparatus in a paper entitled "Depreciation as Related to Electrical Properties." This paper discussed the application of terms defining depreciation, physical value, development expenses, intangible or overhead values, original cost, cost of reproducing new, or cost of reproduction, scrap value, going value, service value, present value, growing value, good will and franchises, constituting a deeply intellectual study of the whole subject of depreciation as applied to electrical properties.

Mr. Floy is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society, the New York Electrical Society, and served as a member of the International Committee of Awards at the St. Louis Exposition, 1904. He is also a member of the Phi Beta Kappa, Psi Upsilon and Theta Nu Epsilon fraternities, the Engineers', Cornell and City Lunch Clubs of New York. He is the author of the textbook entitled "High-Tension Underground Cables," the Colorado Springs Lighting Controversy referred to above, and numerous other contributions which have appeared in the technical press of this and foreign countries.



Henry Floy,
Consulting Engineer.

Exports of copper during March totaled 26,764 tons as compared with 23,200 tons for the same month last year.

April Meeting of Institute Board.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers held on April 5, 72 associates were elected to membership and 78 students were enrolled. The following associates were transferred to the grade of member: E. E. Clement, V. Karapetoff, B. P. Rucker, J. H. Morecroft, and H. M. Gassman.

The organization of a branch at Lafayette College, Easton, Pa., was authorized.

Richard O. Heinrich, Berlin, Germany, was appointed local honorary secretary for that country.

President Dunn announced that the presentation of the Edison medal to George Westinghouse would be made at the Boston convention in June. This medal was awarded by the Committee last December.

A report was made by the Reception Committee which arranged a dinner for C. E. L. Brown, of Switzerland, on April 2 for the purpose of presenting him with a certificate of honorary membership. The dinner was attended by members of the Board and several past-presidents.

The President was authorized to appoint three Institute representatives upon a committee to consider the joint use of poles. Farley Osgood, P. H. Thomas and F. B. H. Paine were appointed upon this committee. This matter was brought up by the American Electric Railway Association, which invited the American Institute and other organizations to participate in membership upon the joint committee.

A resolution was adopted endorsing the holding of a convention in New York City some time between January 1 and April 1, 1913.

A resolution was adopted authorizing the Committee on Relations of Consulting Engineers to prepare a code of fees and rules of procedure and to confer with similar committees of other societies.

Paris Railway System Electrifies.

A cable dispatch from Paris, France, states that the West State Railroad has decided to electrify its complicated Paris suburban system, over which are operated many hundreds of trains daily. The electrification will extend on all lines as far as Versailles, St. Germain and Argenteuil. The necessary plans are being drawn up.

Program for National District Heating Association Convention.

The National District Heating Association will hold its fourth annual convention in Detroit, Mich., on June 25, 26 and 27, 1912. The program for the convention is as follows:

First session, Tuesday, June 25, 10 a. m.—Addresses of welcome, by the Mayor of Detroit, and Alex Dow, of the Edison Illuminating Company. Response, Geo. W. Wright, Baltimore, Md. President's address. Report of Executive Committee. Report of Secretary-Treasurer.

Second session, Tuesday, 2:00 p. m.—Report of Meter Committee, A. P. Briggs, Detroit, Mich., chairman. Paper, "Common Sources of Trouble in Customers' Installations," Wm. E. Darrow, Merchants' Light, Heat & Power Company, Indianapolis, Ind. Paper, "Quality of Steam as Served by Central Stations to their Customers," A. C. Shepherd, Cleveland Electric Illuminating Company, Cleveland, Ohio.

Third session, Wednesday, June 26, 9:30 a. m.—Nomination and election of officers. Report of Committee on Rates, R. D. DeWolf, Rochester Railway & Light Company, Rochester, N. Y. Paper, "An Analysis of Heating Rates," A. E. Duram, Central Station Engineering Company, Chicago, Ill. Report of Committee on Central-Station Records, H. R. Wetherell, Peoria Gas & Electric Company, Peoria, Ill.

Fourth session, Wednesday, 2:00 p. m.—Paper, "Heating in Connection with Curtis Steam Turbines," August H. Kruesi, General Electric Company, Schenectady, N. Y. Paper, "Description of a Combined Steam Heating, Ice Making and Electric Power System," J. T. Lewis, Manager, Murphy Heating Company, Detroit, Mich.

Fifth session, Thursday, June 27, 9:30 a. m.—Paper, "Description of a Large Hot-Water Heating System," G. E. Chapman Public Service Company, of Northern Illinois, Chicago, Ill. Paper, "De-centralized Steam Plant," S. M. Bushnell, Chicago, Ill.

Sixth session, Thursday, 2:00 p. m.—Paper, "Depreciation in Underground Distribution Plants," W. Jennings, Harrisburg Steam Heat & Power Company, Harrisburg, Pa. Paper, "Economic Survey of Combined Power & Heating Systems," E. D. Dreyfus Westinghouse Machine Company, Pittsburgh, Pa. Symposium descriptions of underground insulation, by a number of manufacturers of such insulation.

The entertainment features for the convention are as follows:

For the ladies, Tuesday afternoon, automobile ride.

For all, Tuesday evening, theater party at Temple Theater.

For all, Wednesday afternoon, boat trip to the Flats, with afternoon session on the boat and supper at the Flats.

For the ladies, Thursday morning, card party.

The Association has charge of the exhibit hall and arrangements for space at the exhibit should be made directly with the secretary. The headquarters will be at the Hotel Cadillac, and reservations for rooms should be made directly with the hotel management. All inquiries regarding the convention and exhibit space should be directed to D. L. Gaskill, secretary, Greenville, Ohio.

Cleveland Electrical League Hears Inspiring Address on Co-operation.

At the noonday meeting and luncheon of the Cleveland Electrical League, held at the Gillsy House, on Friday, April 12, A. J. Leitch, business counsellor, Cleveland, O., made a most interesting and inspiring address on "Co-operation."

Mr. Leitch roused his large audience to a high pitch of enthusiasm vividly painting a word picture of the historical and present examples of beneficence and industrial economy accomplished as the result of intelligent co-operation. He also pointed out the demoralization that results, when without co-operation, the influences making for the betterment of the individual and the increasing of efficiency are negative and the elements set working against each other.

David Aitken, president of the League, made an announcement and called for suggestions with regard to the Summer picnic. There were 132 members and guests in attendance, the meeting being held under the direction of Howard Dingle, chairman for the day.

The Yellowstone Park Special from Seattle.

In connection with the Seattle convention considerable inquiry has arisen in regard to the possibility of visiting the Yellowstone Park on the homeward trip, on the part of those who will not be traveling by the special trains de luxe that make the Park one of the objective points of their itinerary. Charles H. Hodskinson, master of transportation, has given great thought and study to this question, as it is likely that many members and their friends will want to accomplish this if it can be done within reasonable time and expense.

With the advice of Mr. Hodskinson, the Northern Pacific Railway has therefore organized a special excursion party for the Yellowstone National Park, the train to be known as the Yellowstone Park Special, which will make the trip thither two days after the close of the convention; namely Sunday, June 16, continuing via Minneapolis and St. Paul to Chicago, where it will arrive on June 27. If one hundred or more people make the trip this special will be a definite certainty, and if less than that number are enrolled they will be handled on the same schedule, in extra equipment on the famous North Coast Limited. The party will be escorted by a representative of the Northern Pacific Railroad and A. M. Cleland, passenger agent of the company at St. Paul, will be glad to send the special pamphlet giving full details as to this excursion.

Institute Meeting at Schenectady.

A meeting of the American Institute of Electrical Engineers is to be held at Schenectady, N. Y., on May 17 under the auspices of the Schenectady Section. Demonstrations of high-tension line phenomena will be given, and the following program of papers has been arranged: "The Induction Generator," by H. M. Hobart; "Electrical Characteristics of Suspension Insulators," by F. W. Peck, Jr.; Propagation of Impulses on a Transmission Line," by J. H. Cunningham and C. M. Davis; "Ozone; Its Properties and Its Commercial Production," by M. W. Franklin; "Protection Against Surges on Electric Railways," by E. E. F. Creighton, F. R. Shavor, and R. P. Clark; "Lightning Protection for 2,300-Volt Pole Transformers," by E. E. F. Creighton and F. R. Shavor; "Multi-Discharge Recorder for Recording Switching and Lightning," by E. E. F. Creighton, H. E. Nichols, and P. E. Hosegood; "Modern Construction of Transmission Lines," by R. A. Worcester; "Some Impressions of the Electric-Traction Situation in Europe," by C. E. Eveleth; "Notes on the Actual Cost of Electrification," by J. R. Hewett; "Gas-Electric Cars," by E. E. Kimball; "Freight-Train Tests on an Electric Interurban Railway," by S. T. Dodd; "The Generator in Transmission Work," by D. B. Rushmore; "Instantaneous Variation of Candlepower of Lamps as Affected by Dynamo Regulation," by H. F. T. Erben.

Meeting of Electric Development League.

At the meeting of the Electric Development League in San Francisco on April 9 a short talk was given by A. M. Searle of the Rochester Railway & Light Company, who advocated the development of the electric art. Mr. Searle has been in California for several weeks gathering information. He dwelt in his talk not only upon the commercial development but the financial development, both of which are advancing rapidly in that state. There were 125 members present.

Electric Power Applications on the Farm.[1]

By Frank Koester.

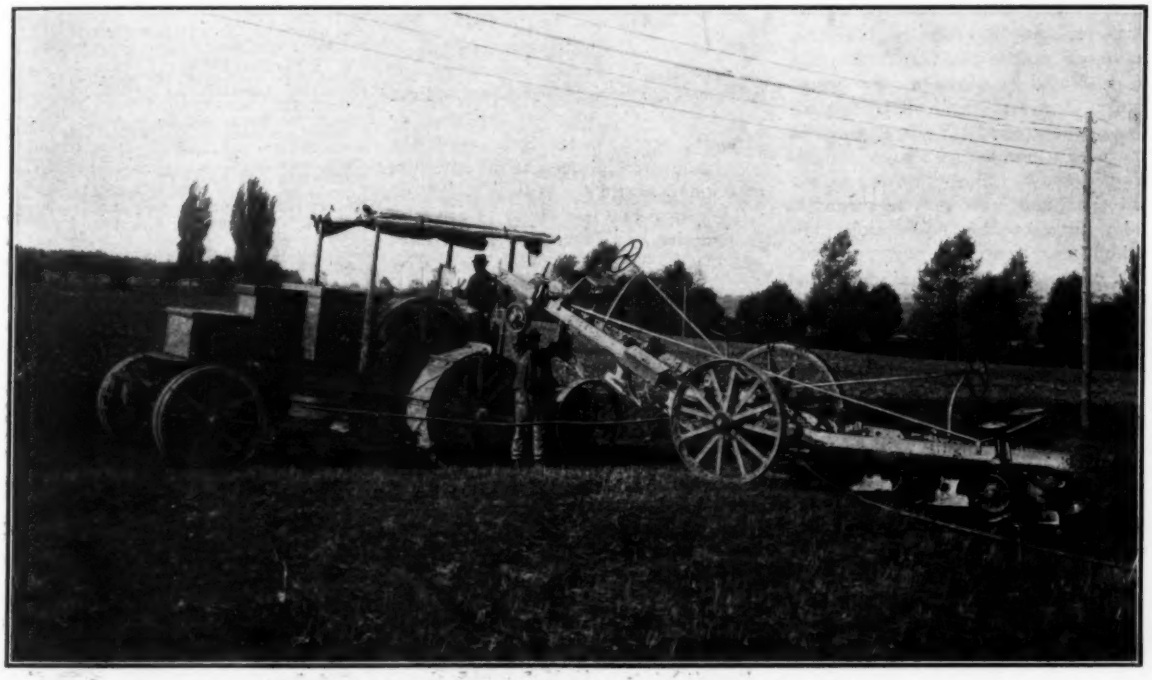
Electric Plowing.

One of the most important applications of electricity in the agricultural field is the electric plow. The design and operation, however, are radical departures from the steam or gasoline-operated plow. Since some 15 years, farmers in Germany, where the steam plow has been used to a great extent, have made use of the electrically-operated plow. The modern electric plow is far beyond the experimental stage, and today we find numerous German farmers taking advantage of the electrically-operated plow, which in many respects is superior to the steam or gasoline-operated plow, to say nothing of the plow driven by draft animals.

It is a well known fact that German farms produce more per acre than farms in our country; and in making use of electrically-operated plows in Germany, the farmers and land owners had good reasons; that is, there would be a saving in time and money in producing the present output. The following table gives the approximate cost of energy necessary for the operation of about 80 per cent of a 1,200-acre farm of which 750 acres are devoted to grain, 300 acres to beets, potatoes, etc.:

APPROXIMATE COST OF POWER AND LABOR OF ELECTRIC PLOWING.

Depth of Furrow	4 inches.		8 inches.		10 inches and 6 inches subsoil.	
Acreage	600		360		600	
Acres cultivated	480	120	240	120	360	240
Months	July Aug.	Sept.	Aug. Sept.	Mar.	Oct.	Nov.
Acres cultivated per 14-hour day.....	21	21	21	21	16.8	16.8
Acres cultivated per hour	1.5	1.5	1.4	1.4	1.2	1.2
Plow in operation in hours	320	80	160	80	300	200
Power consumed per hour in H. P.....	75	75	90	90	105	120
Power consumed per acre in H. P.....	50	50	60	60	70	80
Cost of power per acre at 3 cents per kilowatt-hour	$1.00	$1.00	$1.20	$1.20	$1.40	$1.60
Cost of plowing per acre including labor at 15 cents per hour (two men)	1.20	1.20	1.40	1.40	1.60	1.80



Electrically Operated Plow at the End of a Furrow—Ready to Tilt.

There are in Germany in successful operation two different systems, known as the single and double-motor systems. Both methods attain the same result; that is, a plow is pulled across a field by means of a cable wound on a drum. The single-motor system utilizes one motor-wagon and a so-called anchor-wagon, while the double-motor system has two motor-wagons. The single-motor system has an endless cable running around the drum of the motor-wagon placed on one side of the field, thence around the sheave of the anchor-wagon on the other side of the field; between the motor and anchor-wagon, the plow is pulled back and forth. One man operates the motor, another is required for the plow.

After the plow has covered a course across the field, the plow operator tips the plow so that another set of plowshares is ready to turn furrows in the opposite direction. The motion of the drum on the motor-wagon is reversed and the plow is pulled back across the field. By a certain device on the motor and anchor-wagon, after the plow has traversed the field in one direction, both motor and anchor-wagon advance just enough to start the plow on a new furrow. As it is necessary that the anchor-wagon remain in a fixed position while the plow is traveling, the

1 Copyright, 1912, by Frank Koester.

rims of the anchor wh ls are provided with large flanges which, by the pull of the plow cable are forced into the ground.

The two-motor-plow system consists of two motor-wagons, and the plow is attached to same by a single cable. The plow is pulled back and forth by one or the other motor. The plow and each motor-wagon has an operator, so that three men are necessary to operate this system. The wheels of the motor-wagon have broad rims to give a large bearing, thus aiding the machine to travel over soft ground. The rims are provided with flanges so that locomotion over any kind of ground is readily accomplished. Tl e rims of the forward wheels are provided with large flanges se at right angles to the pull of the plow cable; this arrangement gives an anchorage when the cable becomes taut.

The plow is so designed that it can turn furrows in both directions. When it has reached the limit of travel in one direction, it is tilted in the reverse and is ready to plow on the return travel. One set of plowshares is always in the ground. By equipping the plow with a number of shares, a number of furrows can be turned at the same time, and more ground turned in a day than by the horse and plow method.

The motor-wagon has trailing behind a reel of cable which is paid out as the machine advances. One end of the cable is plugged in at a transformer and the other end is connected to the motor of the winding-wagon. The cable is flexible, is well insulated and can be laid on the surface of the ground without any danger.

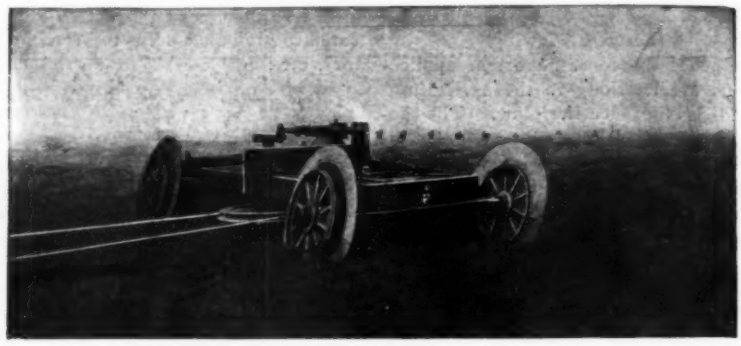
It might be of interest to give some facts and figures regarding the speed of an electrically-operated plow. The test figures given were tal n in the early development of the system at Albrechshausen, Germany, in May, 1900. The length of the furrows were 1,200 feet; the plow possesses four shares, so that the width of the ground turned was 3.25 feet. The speed of the plow was approximately 200 feet per minute. As the tilting of the plow required 45 seconds at each end of the travel, this means that 0.75 acre was turned per hour. The size of motors and machinery required for electric plowing depends on the depth and number of furrows turned at the same time; in this particular case, the furrows were nine inches deep, and four were turned simultaneously; and the power required at the station was 40 horsepower.

Such a plow system can continue for hours and days, and does not need a rest. The only work of the operators is shifting levers, and turning on the power; the plowing ceases only when the men leave the work at night. With the early construction of the electric plow only three-fourths of an acre could be turned in an hour; today with fifteen years of improvement, twice as much can be turned in the same time.

Figuring the energy consumed, at two cents per horsepower-hour, and the cost for labor at 15 cents per hour, or 45 cents per hour for three men, the cost of one acre plowed at the rate first mentioned would be $1.49.

There are but few farms of any size in America, which can be plowed for the above figure by plows pulled by horses or steam engines. Although the first cost of the electric plow is high, attention is brought to bear on these facts. An electrically-operated plow can be operated practically at all seasons, where a steam-operated plow will freeze up in cold weather, and horses cannot work in soft or loamy soil, or on hilly ground. In addition, steam-operated plows consume a great amount of steam which necessitates many teams and drivers to haul fuel and water over the soft ground to where the plow is at work.

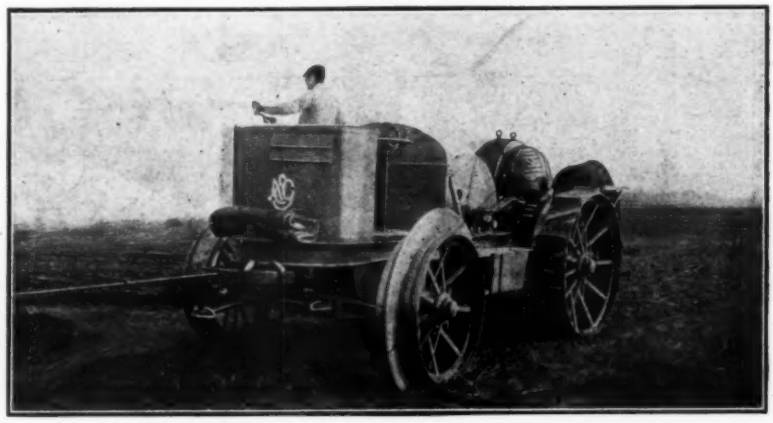
The following table gives the comparative figures of first cost, operation, etc., of a steam-plow system, and an electric plow, both for single and double-motor systems:



Anchor Wagon of Single-Motor Plow System.

COMPARATIVE COST OF PLOW SYSTEMS.

System.	Steam	Electric 2 motors	Electric 1 motors
First cost (complete equipment)	$15,000	$11,250	$8,750
Interest, per cent.	4	4	4
Amortization, per cent	4	3	3
Repairs, amortization-rate according to use, per hour, per cent	.010	.005	.005
Number of men	4	4	3
Coal consumption, per hour, at $6.00 per ton	$0.60		
Energy consumption per hour in kilowatt-hours		30	33
Cost at 3 cents per kilowatt-hour		.90	.99



Motor Wagon of Two-Plow System.

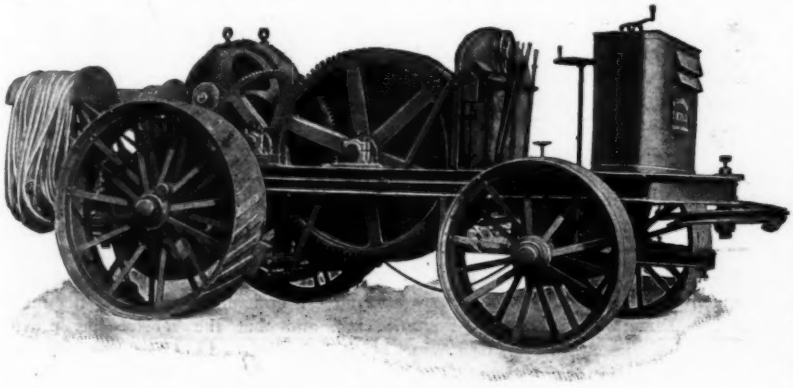
The following table of operating and maintenance costs is based on a 12-hour day, for 100 days of the year:

MAINTENANCE OF PLOWS.

Kind of Plows.	Per Hour.	Per Hour.
For steam plow	$4.10	$3.28
Electric plow—2 motors.	2.95	2.36
Electric plow—1 motor .	2.60	2.10
Team	3.25	2.60

It must be borne in mind that the above figures are comparative and are taken from data on plowing as done in Germany and under German conditions. It is an established fact that American agricultural machinery, and its wide practical application, in most

respects, is far superior to that of any foreign make. If our domestic manufacturers would devote themselves with the same skill to the field of electric



Motor Wagon of Single-Motor Plow System.

plowing, it would be a question of only a short time when the farmer would recognize the advantages of electric plowing.

The system of electric plowing is not confined to farms of small acreage, on farms of 15,000 acres and more this system is readily applicable, and actually carried on with advantageous results, as well as on small farms of 50 acres.

Improved Design of Electrically Operated Plow—Two-Motor System.

There are no fixed rules by which the capacity of an equipment for plowing a given field can be ascertained. Each case must be investigated thoroughly by an engineering expert, who is not only well versed in mechanical and electrical equipment, but also familiar with farming, so that a combination system of electric farming can be laid out with the minimum of expense, which includes interest, depreciation, repairs, insurance, wages, etc. Features of the single-motor and two-motor systems are shown in the accompanying illustrations.

Electrically Operated Refrigerating Plants.

Nearly every farmer can make use of a cold-storage plant, in order to keep meat in proper condition, and to prevent butter, milk, eggs and other perishable goods from spoiling. The greatest benefit of such cold storage for the farmer lies in the fact that he is not forced to ship his goods immediately to the market; he can store the goods until the market prices advance, and then receive a higher price than he otherwise could get without cold-storage advantages. In many cases, especially with fruit, the farmer is forced to let his fruit lie on the ground and rot, because the price offered does not pay his expenses of picking, packing and shipping his goods to the commission merchants. A cold-storage plant would enable him to pick fruit in the proper season, and keep it in storage until he receives his own price.

Some kinds of fruit are better adapted to storing in cold temperatures than others, and are in active demand through a longer season. Winter apples and pears can be kept in good condition for long periods in cold storage, and a large part of the late apple and pear crops is now held in cold storage annually to insure a supply of these fruits in good condition throughout the winter and spring months. Upon the other hand, berries and other small fruits are not stored to nearly so great an extent on account of their highly perishable nature.

The storage of small fruits is a problem somewhat different from the storage of the more durable fruits. Winter apples and pears are usually too hard and immature when stored to be fit for immediate consumption. Cold storage insures the safe keeping of these fruits for long periods, and under proper management brings out their finest flavor and quality. The fruits ripen slowly in the low temperature of the storage house, and acids diminish; the starch changes to sugar if the transformation is not already completed when the fruit is stored, and the fine flavor and aroma of the fruit is developed.

Small fruits held in cold storage are placed there to protect the fruits temporarily from decay until they can be placed in the hands of the consumer. Shipments of small fruits are frequently delayed in transit and reach their destination too late for the early morning market. There is often little opportunity of disposing of them until the following morning, or in case of the late arrival coming on Saturday the fruit can not be sold until the following Monday morning. Without artificial refrigeration, the fruit would deteriorate rapidly, and in many cases would become worthless before it could be sold. Under these conditions it may be saved by placing it temporarily in cold storage. An overstocked market sometimes results in the cold storing of considerable quantities of small fruits when there is a reasonable prospect for a stronger demand and better prices within two or three days.

Where the steam-electric plant is of considerable size, supplying a number of farms with electric energy, it is an economical proposition to utilize the exhaust steam for making ice. For instance, a small plant, of 100 horsepower, operating twelve hours per day, and figuring that the steam consumption of the engine is twenty pounds per horsepower-hour, some six tons of ice daily can be made as a by-product and distributed among the farms concerned. To put such a proposition on an economical and paying basis, for the installation of an apparatus using the exhaust steam for ice-making, the services of a competent engineer for the planning and installation is likewise a wise investment, as it encounters considerable scheming to get all the component parts fitted so that a harmonious oper-

ation is the result. Once installed, the apparatus can be handled as easily as any farm machinery, and does not require constant attention; it is simple in operation.

People are becoming more and more alive to the superiority of refrigerating machines, popularly called "ice machines," for producing the cooling effects for which natural ice is now employed. Such a machine can be used to make ice, which will be more solid and will last longer than the natural product, being as far preferable to ordinary ice as that is to snow ice, and which can and should be made from water of known purity so as to make an absolutely hygienic ice. More often, however, it is simpler and more economical to let the machine itself do the cooling that ice was formerly employed to do, equipping it, if desired, with auxiliary appliances to make ice in small quantities, as for drinking water or to make ice cream. By mechanical refrigeration, boxes and chill rooms are given a dry, clean coldness that, even when above the freezing point, preserves their perishable contents much longer than is possible with ice placed in an overhead bunker or used in any other manner. Each compartment is given the temperature especially adapted to its particular contents. And if freezing temperatures are desired for the long storage of butter, poultry, fruit and other articles, a refrigerating machine is a practical medium.

Sometimes the machine is made to chill brine, which is then pumped into lines of piping, arranged along the top or sides of the room to be cooled, this being known as the "brine system." A simpler method, and usually the preferable, is the "direct-expansion system" in which anhydrous liquid ammonia passes directly into the pipe lines, called "expansion coils" and as it vaporizes takes up the heat from the chill room, fresh-water tank, or other place that is to be kept cold. In either system, where a room is to be refrigerated, the piping is placed behind non-conducting shields, so as to insure a proper circulation of the cold air.

This principle of physics, that the vaporizing of a liquid will take up heat from surrounding objects, is at the basis of nearly all of the present-day commercial machines. And all things considered, for practical purposes, anhydrous ammonia, usually designated simply as "ammonia" is the best refrigerating agent. (The ammonia that produces the refrigerating effect is not to be confused with the common aqua ammonia, which is ammonia gas in solution in water. But if such gas is driven off by heating the solution and is then cooled under sufficient pressure, anhydrous liquid ammonia is obtained.) If one pound of anhydrous liquid ammonia is allowed to pass from a small orifice in the vessel containing it into pipe lines, where it expands to a gas, it will in vaporizing take up enough heat through the walls of the piping to lower the temperature of rather more than 500 pounds of water one degree, or in other words to absorb over 500 British thermal units. But after having done this work, the ammonia, now in a gaseous form, has exhausted its capacity of absorbing heat until it has been made dense by compression and has been cooled by passing through pipes in contact with flowing water, such as is drawn from street mains, so as to bring it back to liquid form.

Where there is electric current available on the farm or country estate, an electric motor is readily applicable to a small refrigerating plant, which is nothing more than an ammonia compressor, generating a cold temperature as low as practicable. Such a generating set does not need to operate continuously, only a few hours twice a day, to keep a constant temperature in the cold-storage room. When the temperature drops, the machine automatically starts and operates until the set temperature is reached, when it automatically stops. The greatest variation in temperature is not more than five degrees.

The advantage of this refrigerating system is that all the moisture in the air collects on the pipes as frost, leaving the air practically dry, while with the use of ice, the air is more or less moist. Such an atmosphere is not the best for keeping some kinds of fruit and vegetables for a considerable length of time.

One of Life's Little Irritations.

To come home from the office and find that your wife has purchased an electric flatiron, when the house is not wired. She expected to attach it to the telephone.—*Edison Weekly.*

High-Voltage Motors in Mine Service.

Formerly it was thought that the use of the high-voltage alternating-current motor in deep mines was impracticable. Two obstacles to such service were considered; namely, that of securing a safe, substantial support for the high-pressure conductors from the surface down to the motor, and that of safeguarding the motor against excessive moisture. It is interesting, therefore, to learn that the Empire District Electric Company has been installing 2,200-volt induction motors in the mines around Joplin, Mo., the depth of the motor below the surface being several hundred feet in many cases, and that the service has proved entirely satisfactory. The company has found that by a proper study of the problem all the seeming difficulties may be easily overcome.

The work of the Empire Company in the mining district referred to, it may be added, is a striking illustration of what can be accomplished in the way of power sales by a careful study of engineering problems, combined with vigorous and systematic new-business campaigns.

Single-Motor Plow in Action.

Nine years ago the Empire District Company had not a single horsepower of connected load in any of the mines; today the mining load on its lines is approximately 20,000 horsepower. Moreover, a strong force of solicitors and engineers is kept busy now, with the result that the load is constantly increasing.

The company owns and operates four large generating stations near Joplin, and when the hydroelectric station of the Ozark Power and Water Company on White River is finished, transmission lines from this plant will also supply power to the Empire Company's system.

Power will be transmitted from the Ozark plant, near Forsyth, Mo., a distance of about 135 miles. Near Joplin the voltage will be stepped down to 33,000, which is the pressure at which the transmission system of the Empire Company is operated. Transmission is at 66,000 volts.

Commercial Practice
Management, Rates, New Business

ELECTRIC RATES.

By Herman H. Spohrer.

The Union Electric Light & Power Company of St. Louis has adopted a schedule of rates, set forth in this article, that, while permitting of a considerable reduction to customers, insures a satisfactory return on the investment. The new rates have been approved by the courts and are in accordance with the recommendations of the Rate Committee of the N. E. L. A.

Although the average rates for the various classes of electric service throughout the country show a remarkable similarity, the systems employed in arriving at these rates are so greatly at variance that the situation is rather perplexing, particularly to consumers doing a national business, having representation in numerous cities and are required to contract for service under some different arrangement in practically every city.

A few of the more interesting points about the new rate schedules adopted by the Union Electric Light & Power Company, St. Louis, Mo., may be summed up as follows: The true non-discriminating system of rates is one in which the charge to the customer bears a definite proportion to the cost of supplying him. The demand system of charge tends to make the charge to the customer proportionate to the cost. Of course, it does not accomplish this result absolutely. Even when least well-devised, it is a long step in that direction. The fundamental principles are the following:

Instead of basing the charge of the customer's consumption as is done with the flat meter-rate system, or upon the obsolete flat monthly rate based on the size of load, the charge is based on both consumption and demand. The demand system recognizes that a charge must be made on the consumption to prevent waste, and also a charge made on the maximum demand, since the major portion of the expense to the company in furnishing the service is proportional to the maximum demand. Approximately from 15 to 20 per cent of the expense is represented by generation and distribution, and is therefore proportional to the output, and from 50 to 60 per cent represents taxes, depreciation and legal rate of return on the investment, and is proportional to the maximum demand. The remaining 20 to 35 per cent are then distributed over the other two charges in the most advisable or expedient manner, and represent the customer's expense. These expenses are, as a rule, classified as follows: The tax, depreciation and interest on investment charge is termed the maximum demand or capacity charge; the general expense, the customer's charge; and cost of generation and distribution, the energy charge. In the practical application of these systems, they have been further condensed into a demand and an energy charge.

Briefly, the two demand systems most generally used are the Hopkinson, which employs a primary or capacity, and a secondary or energy charge, and the Wright system, which consists of a two-step rate, the first or higher step designed to approximate the capacity charge, and the second the energy charge.

The Railroad Commission of Wisconsin recognized the desirability of this method of charge in the Beloit case, in which there is a primary rate of 13 cents gross per kilowatt-hour for current used equal to or less than the first 30 hours' use per month of the active connected load; a secondary rate of eight cents gross per kilowatt-hour for additional current used equal to or less than the next 60 hours' use per month of the active connected load, and an excess rate of five cents gross per kilowatt-hour for all current in excess of the above 90 hours use' per month of the active connected load. The active connected load is indicated as a fixed percentage of the connected load, consisting of lamps, appliances, etc., installed upon the consumer's premises. Where the total connected load is equal to or less than 500 watts, 60 per cent of such connected load is indicated as active. Where the installation exceeds 500 watts, 33.33 per cent of such a part of the total connected load over and above 500 watts is indicated as active.

Objections to use of the connected load as a basis of charge are: (1) difficulty of keeping correct record of connected loads; (2) annoyance of customer by frequent inspections; (3) heavy cost of necessary service counts; (4) extensive use of electricity, due to throttling the installation of convenient lights, discouraged; (5) overloading motors too small for that particular service and consequent poor service and dissatisfaction.

There are also objections to the demand systems based upon the measured demands because they require a considerable investment represented in the installation of demand-recording instruments; also additional operating cost of reading these instruments and the annoyance, having introduced an additional element of discrepancy between the consumer's idea of the demand in any particular month and the registered demand so that disputes may result from not only the watt-hour meter but from the demand meter as well.

Several years ago A. C. Einstein, realizing the difficulties and complications of the rate schemes in existence, devised for the use of the Suburban Electric Light & Power Company, St. Louis, of which he was president, a system of rates to embody the necessary features of the demand charge based upon the area of the premises to be served, a factor which does not fluctuate, and at the same time approximate the capacity with sufficient accuracy for all practical purposes. This rate might properly be described as being based upon the "expediency principle" in that it is a good commercial rate that the consumer understands, and the consumer is able to discuss areas with intelligence.

The Suburban Electric Light & Power Company's rates are described more fully as follows:

COMMERCIAL OR GENERAL LIGHTING.

Rate Schedule.

For first 5 per cent of monthly constant use at 12.5 cents per kilowatt-hour.
For next 10 per cent of monthly constant use at 10 cents per kilowatt-hour.
All over 15 per cent of monthly constant use at 5 cents per kilowatt-hour.

The monthly constant use upon which the above rates shall apply shall be based on the "Assessed Demand" ascertained as indicated in tables below.

"Assessed Demand" (How Ascertained).

For Rooms—
For the first 3 rooms or less, 300 watts.
For the next 4 rooms, 60 watts for each room.
For the next 5 rooms, 40 watts for each room.
For all over 12 rooms, 25 watts for each room.

For Areas—
For the first 500 square feet or less, 300 watts.
For the next 1,000 square feet, 40 watts for each 100 square feet.
For all over 1,500 square feet, 25 watts for each 100 square feet.

Rooms containing in excess of 500 square feet shall be classed as "areas."

Halls, bath, toilet and pantries shall each be counted as rooms—cellar if used for business purposes shall be classed as areas; if for storage at 50 watts.

Exterior lighting, if used in connection with interior lighting Assessed Demand shall be 50 per cent of actual wattage connected, otherwise to be figured on basis of total wattage.

Assessed Demand subject to change and verification by inspection at any time.

RESIDENCE LIGHTING.

Rate Schedule.

For first 5 per cent of monthly constant use at 12.5 cents per kilowatt-hour.
For next 10 per cent of monthly constant use at 10 cents per kilowatt-hour.
All over 15 per cent of monthly constant use at 5 cents per kilowatt-hour.

The monthly constant use upon which the above rates shall apply shall be based on the "Assessed Demand" ascertained as indicated in following tables.

"Assessed Demand" (How Ascertained).

For Rooms—
For the first 3 rooms or less, 300 watts.
For the next 4 rooms, 60 watts for each room.
For the next 5 rooms, 40 watts for each room.
For all over 12 rooms, 25 watts for each room.

For Areas—
For the first 500 square feet or less, 300 watts.
For the next 1,000 square feet, 40 watts for each 100 square feet.
For all over 1,500 square feet, 25 watts for each 100 square feet.

Rooms containing in excess of 500 square feet shall be classed as "areas."

Halls, bath, toilet, pantries and cellar shall each be counted as rooms.

Assessed Demand subject to change and verification by inspection at any time.

POWER.

Rate Schedule.

For first 5 per cent of monthly constant use at 10 cents per kilowatt-hour.
For next 10 per cent of monthly constant use at 8 cents per kilowatt-hour.
All over 15 per cent of monthly constant use at 4 cents per kilowatt-hour.

The monthly constant use upon which the above rates shall apply shall be based on the "Assessed Demand" ascertained as indicated in tables below.

"Assessed Demand" (How Ascertained).

One Motor—
For first 10 horsepower, 700 watts per horsepower connected.
For next 20 horsepower, 600 watts per horsepower connected.
For next 70 horsepower, 525 watts per horsepower connected.
All over 100 horsepower, 450 watts per horsepower connected.

NOTE:—Lighting load will be included under power rate, provided lamp capacity connected does not exceed 25 per cent of total power capacity connected, and additional demand for lighting load shall be added, based on actual wattage of lamps connected.

"Assessed Demand" subject to change and verification by inspection at any time.

"Assessed Demand" shall be computed on foregoing basis unless tests made at the option of the Company indicate the "Maximum Demand" to be greater, which in that event the Company may apply.

To insure a greater accuracy in assessing demands and to secure a greater refinement, we might assess 60 watts for each 100 square feet in commercial lighting, where lighting is intensive, such as in a jewelry store, and apply 40 watts per 100 square feet in an ordinary store where only moderate lighting is required, and apply a unit of 25 watts per 100 square feet in the case of warehouses or furniture sales rooms where a rather low grade of lighting is used.

Last fall the Union Electric Light & Power Company introduced a room rate for its residence lighting, the underlying principle of which takes cognizance of the demand. It is practically a modified statement of the demand rate, based upon $3.50 per kilowatt of monthly demand, with a five-cent energy rate. It was found by experience that the average demand for the first four principal rooms in residences is 80 watts per room, and for rooms in excess of four, 50 watts per room. The number of kilowatt-hours necessary to absorb the demand capacity charge of $3.50 per kilowatt monthly charge was then solved for, and resulted in four kilowatt-hours per month for each of the first four rooms, and 2.5 kilowatt-hours per month for each of the rooms in excess of the first four. Instead, however, of adhering to the 12-cent maximum rate and to energy rate of five cents, the maximum rate was reduced to 11 cents and the energy or secondary rate was made six cents. The complete rate is therefore expressed as follows: (1) Primary charge of 11 cents per kilowatt-hour for (a) the first four kilowatt-hours consumed per month for each of the first four active rooms; (b) the first 2.5 kilowatt-hours consumed per month for each of the active rooms in addition to the first four. (2) Secondary charge of six cents per kilowatt-hour for all energy in excess of that paid for at the primary rate in (1). Minimum monthly bill shall be $1.00.

Since the lighting consumption in practically all cases is sufficient to earn for the consumer the six-cent rate, it means that the various heating and other electrical appliances can all be operated at the low rate of six cents. It is expected that this low secondary rate will induce the installation and use of numerous appliances. These rates will probably be still further reduced as the density of service increases.

The company is at the present time furnishing residence service clear to the city limits in all directions, although considerable of the territory is very sparsely settled. This rate carries with it a minimum monthly charge of $1.00, the justification of which has been recognized by every court or commission which has considered the matter and is intended to cover the fixed charges of meter investment, periodic cost of inspections or repairs, reading of meters and handling of accounts. The Union Electric Light & Power Company has under consideration at this time the matter of designing a rate for commercial lighting based upon area very similar to that employed by the Suburban Company previously mentioned.

Central Station Secures Pumping Contract.

The Omaha (Neb.) Electric Light & Power Company has recently entered into a contract with the Union Stockyards Company, at South Omaha for the pumping of all water for the stockyards, and later for the various plants located there. At present a daily average of about 4,000,000 gallons will be pumped, but this amount will be increased to 10,000,000 gallons per day when arrangements are completed with the packing plants. The present rate which the stockyards company pays to the city for this service is 4.5 cents per 1,000 gallons. Central-station service will cost between 1.5 and 2 cents per 1,000 gallons.

Another large contract recently secured by the Omaha company is for an installation of 395 horsepower, in motors in the plant of the Peters Milling Company. Individual drive will be installed throughout.

Novel Use for Electric Heaters.

The New York Edison has devised a new use for electric heaters, the successful operation of which has opened up a new field for the use of central-station energy. On the roof of the Trinity Corporation loft building in New York is located a huge water tank which holds the supply of water for the fire sprinkler system. The equipment in this building is known as the "dry system," that is, no water is in the pipes in the building until a fire sets off one of the metal caps. This is necessary in buildings where there is no heat, on account of freezing.

When the system was installed last summer one of the problems that confronted the owners was to make some arrangement to prevent the water in the tank from freezing during cold weather. It was decided to install a number of electric heaters, and experiments were made to learn just how these could be most effectively placed. The best results came from heaters set in the 18-inch air chamber at the top of the tank, and attached to the underside of the air-tight cover. Four heaters, of 1,200 watts each, were installed with a thermostatic control to keep the temperature of the chamber always at 34 degrees Fahrenheit.

The first severe test came on January 5 and 6, when the cold and high winds froze almost everything solid. The effect of the zero temperature on the tank was watched with great interest. The water was found to be entirely free from ice. As soon as the air in the chamber fell to a temperature of 34, the thermostat acted automatically and set the heaters in operation. When the air had warmed sufficiently the current was shut off until it should be needed again.

Water for the tank is pumped to the roof from the cellar, and to keep the pump room at an even temperature of 38 degrees, an 800-watt heater was installed. This is believed to be the first instance where such measures were employed to keep a roof tank from freezing.

Electrical Construction

ACCOUNTING SYSTEM FOR THE SMALL ELECTRICAL CONTRACTOR.

By Roy W. Eves.

There is no doubt that there is considerable room for improvement in the accounting or bookkeeping end of most small electrical contracting businesses. The system here presented should be of use particularly to that class of contractors whose business is of too modest proportions to well afford the much needed services of an experienced bookkeeper; yet the balance of success or failure in this as well as any other legitimate business very often hangs on the accurate knowledge of the condition of the business, both at the present moment and in the past. Slip-shod methods should be avoided religiously; for they often result in direct financial loss, as well as in the loss of confidence of both customers and creditors.

There is no aid to profitable estimating so valuable as that of carefully kept cost records. In connection with the contract cost records here described, estimate records have been purposely omitted. The reader is referred to an artfcle, "Estimating," by George W. Craighead, page 136, January 20, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for very good ideas covering that phase of the business. There have also been omitted many refinements of accounting that would naturally suggest themselves to the expert or experienced accountant as being extraneous to the object of this system, which is to give accurately necessary information with the greatest simplicity of method. The ideas were all gleaned from an observant experience with the system.

The books, forms and binders needed are: Four 5-inch by 8-inch end-fastening loose-leaf binders, 2-inch depth; one 5-inch by 8-inch end-fastening loose-leaf binder, 1-inch depth; three alphabetical indexes, for above binders; supply of 5-inch by 8-inch forms, as per Fig. 1, in duplicate, numbered; supply of 5-inch by 8-inch forms, as per Fig. 2; supply of recapitulation sheets, as per Fig. 3; supply of time cards; three-column or four-column cash book, and standard calendar-desk pad

JOHN DOE
ELECTRICAL CONTRACTOR
104 E. MAIN ST.
SANDUSKY, ILL.

SHIP MATERIAL VIA	ORDER DATE	ORDER NO.
Mer. Desp. Co.	3-10-11	106

Messrs. General Electric Co., Schenectady, N.Y. Enter our order for the following goods to be shipped not later than 3-20-11.

Signed: John Doe

QUANTITY	CAT. NUMBER	PAGE	DESCRIPTION
500	50760	30	¾" Brass shell keysockets
50	60666	22	Edison Weatherproof sockets

Fig. 1—Order Blank.

Requisitions, Invoices, Etc.

In ordering material use form shown in Fig. 1. Send the original, which is not perforated or punched for filing, to the concern from which the goods are ordered, and place the duplicate, which should be punched for filing, in one of the binders marked "Duplicate Orders No. 1." Should an order be given verbally to the salesman he should be given the number of the next blank order and this number placed on his order, or he should be required to write the order on the regular form. His duplicate, should he be required to use his firm's blanks, should be pinned to the regular duplicate and filed, so as to give an identification and a place to each requisition.

The binder should be placed where it will be readily accessible to the receiving clerk, or whoever attends to unpacking shipping cases. When a shipment is received, the duplicate order covering it should be dated, checked with the material, and either OK'd or errors noted on the duplicate. In case of errors or shortage the packing slip or list usually found in every shipment should be attached to the order duplicate.

When invoices arrive, the date upon which payment will fall due should be ascertained and a note of same made on the page of the calendar-desk pad of that date; viz., "E. C. M. Co., $40.80, Inv., 2/10/11." If invoice is subject to cash discount a note of this should be made on the proper page of the calendar. The invoice should then be attached to the order duplicate, as should also the freight bill, bill of lading, acknowledgment of order, and all correspondence relating directly to this shipment. When everything is checked up OK and invoice is ready for payment, all the papers should be filed in "Duplicate Orders No. 2" binder, which should be arranged for alphabetical filing.

A voucher form of check should be used for payment of all accounts. When the canceled check is returned through the bank it should be attached to the rest of the papers; also any receipt or acknowledgment issued by the payee. Should one check cover several invoices all the papers for the several orders should be fastened together. Thus, at all times a complete and accurate record of every order from the beginning to the end of the transaction is kept in one file where it can be seen with a minimum amount of trouble and searching. When the No. 2 binder is full the files that are complete should be removed to a permanent binder or tied in bundles and dated for possible future reference.

Accounts.

All material sold or work done for which the cash is not obtained should be charged out in duplicate on the form shown in Fig. 2. When a charge is

made, both copies should be filed alphabetically in "Bill Book No. 1." All subsequent charges against the same customer should be entered in duplicate on the same sheets. At the time for collection of the account, the original is taken from the binder, mailed or placed in the "Collection Book" (the half-size binder), and a note made on the duplicate of the date and disposal of the original, such as "Mailed 10/8/11," or Coll. Bk. 10/8/11." Should the bill not be paid when presented, or a promise made of payment at some future date, a note should also be made of this on the duplicate, and also on the daily calendar memorandum pad under the date at which it desired attention be called to the matter.

For labor charges, specially prepared time-cards should be used. Every morning each wireman and helper should be given one of these cards, properly dated, so that they can be taken out on the jobs and time entered as each job is completed or left. Each evening when the cards are turned in the items should be taken off on to the various accounts to which they should be charged. The cards should be filed in envelopes, one for each workman, and their time should be figured from these cards. This will make them careful to have the cards made out correctly and to turn each one in at the proper time.

In case of a job that is not on contract, that is to extend over a long period of time, or, in working for customers who habitually dispute time charges, it is a very good plan to instruct the wireman to get the owner or his agent to OK the items on the time card covering his work. This is an easy thing to do and will be found to save time and settle many disputes, besides giving the customer confidence that he is not being overcharged.

When a contract is closed up it should be billed out on the regular form the same as any other charge, except that the amount is omitted from the original and carried in memorandum on the duplicate until the bill is ready for collection. On the duplicate, make memoranda of the items and cost prices of all material, and the labor performed on the job. If work is out of town, include as labor charge all expenses allowed the men. When job is completed, find the value of all material returned and subtract it from the total of material taken out on the job. Then add to this amount an item, "—— per cent handling, $....." The proper per cent to use in this calculation is obtained as follows: Obtain from the past year's business these amounts:

(1) Total freight and drayage bills.

(2) Two-thirds of total postage and stationery bills.

(3) Three-quarters of total wages of non-productive office and shop help and allowance of proprietor.

(4) Three-quarters of total rent, heat, light and advertising bills.

Multiply this total by 100 and divide by the total amount paid out for material for the past year. Add to the total labor charges on the duplicate an item "——per cent, Supervision, $——." The proper per cent to use in this calculation is obtained as follows: Obtain from the past year's business these amounts:

(1) Total amount of depreciation and loss of shop tools as shown by the inventory.

(2) Total car-fare, hauling, etc.

(3) One-third of total cost of postage, stationery.

STATEMENT OF BUSINESS FOR THE YEAR 1912.

	Dr.	Cr.	Loss	Profit
Previous Inventory (less unpaid invoices)	1,500.00			
Present Inventory (less unpaid invoices		1,900.00		
Cost of Material (column 4)	7,000.00			
Received for Material (column 2)		7,500.00		
Profit on Material				900.00
Cost of Labor (column 5)	3,500.00			
Received for Labor (column 3)		3,800.00		
Profit on Labor				300.00
Expense (column 6)	360.00		360.00	
Net Profit	840.00		840.00	
	13,200.00	13,200.00	1,200.00	1,200.00

	Assets	Liabilities
Accounts receivable (from Bill Book)	550.00	
Accounts payable (unpaid invoices)		300.00
Cash on hand	150.00	
Gross inventory	2,200.00	
Present worth of business		2,600.00
	2,900.00	2,900.00

(4) One-fourth of total cost of wages of non-productive office and shop help and allowance of proprietor.

(5) One-fourth of total rent, heat, light and advertising bills.

Multiply this total by 100 and divide by the total amount of wages for the year. This method will give the true instead of the apparent cost of a job. The amount of net profit should now be ascertained and proportioned between material and labor according to their relative amounts and entered the same as an item of labor or material.

If a loss shows up on the job, ascertain from the estimate whether it was the estimate on material or labor that was exceeded and throw the loss to the proper account, entering it on the duplicate in red ink. If the loss shows against material subtract the amount from the total of material and use the remainder for posting as shown later. If a labor loss, enter in red ink and clear the amount as shown under instructions concerning "Cash-Book."

At the end of the month go through all the duplicates and post each item of labor or material in the proper column of the "Recapitulation Sheet" (Fig. 3). Make a distinct check mark on each item as posted, so that the next month the same items will not be re-posted. When coming to a contract duplicate do not post any red-ink labor items; nor the material totals until the items of material returned and profit or loss have been figured out. When each item on a duplicate has been checked and the bill stamped "PAID" it should be removed and filed alphabetically in "Bill-book No. 2."

Cash Book.

For the "Cash Book," obtain a four-column cash-book or a three-column book and rule in an extra column on each right-hand page. On the left-hand page, or the "debit" side, enter all items of cash received, and on the right-hand page, or "credit" side, show all money paid out. Head the columns: "General," "Material," "Labor," and "Expense." In the "General" column the amount of every cash transaction is entered for the purpose of balancing the cash each day.

On the debit side amounts received in payment of accounts in the bill book are not extended to the other columns, but all items of cash received for material that has not been charged out in the bill book, should be extended to the second or "Material" column; and all items of cash received for repair work, etc., should be extended to the third or "Labor" column.

On the credit page (right-hand), all items of payment of invoices, freight,

and drayage, extend to the second, or "Material" column. All items covering the productive wages of wiremen, helpers, or apprentices, car-fare, hauling tool boxes, railroad fare and expenses on out-of-town jobs, extend to the third, or "Labor" column. All items of rent, heat, light, power, postage, stationery, advertising, and all wages or proportion of wages for unproductive labor or supervision, such as office help, janitor work, etc., extend to the fourth, or "Expense" column.

When the cost memorandum of a "NG" and also the date, and file in a special compartment in the duplicate bill book, marking on it an explanation of the reason for the bill becoming uncollectible. Then enter the amount of the bill, or the uncollectible portion of it, in both "General" columns; extending the portion of the bill consisting of labor to the "Labor" column, and the portion of the bill consisting of material, to the "Material" column on the credit side. Mark in the explanation column the name of the bill and the word "uncollectible."

"Labor Receipts," "Pd. for Mdse.," "Pd. for Labor," and "Expense." Enter under these headings all items shown below:

(1) "Month."
Month.

(2) "Merchandise Receipts."
Material total from monthly recapitulation sheet. Total of "Material" column on debit side of the cash book.

(3) "Labor Receipts."
Labor total from monthly recapitulation sheet. Total of

JOHN DOE
ELECTRICAL CONSTRUCTION AND SUPPLIES
404 EAST MAIN ST.
SANDUSKY, ILLINOIS.

In Account with Jan. 15 1911

Mr J. K. Lamb
416 Main St.

Jan	1	12-50w. carb. lamps	2	40	
	3	1 2-lt. fixture	7	00	
	3	2 hrs. install fix.	1	00	
	"	1 Snap switch		30	10 70

Fig. 2—Statement.

RECAPITULATION
For Month of March 1911

MATERIAL			LABOR		
10	27	26	4 00	82	75
7 20	7	18 20	4 00	4	00
4 32		9 00	2 00	3	00
1 10		4 32	1 50	3	50
20		68	50	3	50
04		79	50	3	50
82		1 70	25	4	00
06	31	00	1 25	1	75
91	108	04	3 00		75
12 50		61	3 50		50
2 00		02	2 75	2	50
2 00		38	4 00	4	50
4 10		49	4 00	5	00
85		14	1 50	5	00
10			1 50	4	00
20			2 25	4	75
30			2 50	4	75
30			4 00	3	25
09			4 00	3	25
18 00			3 50	5	00
41 00			3 00	5	00
2 20			2 75		50
3 10			3 75		25
98 12			2 00	1	25
16 00			1 00	2	50
05			1 00	4	00
9 10			3 50		
1 00			2 25		
1 00			1 75		
1 80			3 25		
21 00			4 00		
TOT 23 10			4 00		
272 66	447	43	82 75	162	75

Fig. 3—Recapitulation Form.

contract shows a loss (written in red ink as previously instructed), it means that money has been expended for labor that will not be balanced by the face of the contract, and, as all labor has been entered and posted, the amount of the loss should be cleared by entering in both "General" columns; and on the credit page, the amount should be extended to the "Labor" column. In the explanation columns the word "Loss" and the name of the job should appear.

To clear the amount of an uncollectible bill so that the books will not be thrown out of balance, mark the bill

Each day the "General" columns should be balanced to detect any error in the cash entries. At the end of the month, after the "General" columns have been balanced, all the other columns should be totaled and the amounts posted to the recapitulation sheet as noted below.

Recapitulation.

The totals of the items posted from the duplicate bills to the monthly recapitulation sheet (Fig. 3) should be posted to the yearly recapitulation sheet, together with the cash book totals, as follows: Head the six columns. "Month," "Mdse. Receipts,"

"Labor" column on debit side of cash book.

(4) "Paid for Merchandise."
Total of "Material" column on credit side of the cash book.

(5) "Paid for Labor."
Total of "Labor" column on credit side of the cash book.

(6) "General Expense."
Total of "Expense" column on credit side of the cash book.

Use the year's total of these columns to obtain a complete statement of the business, as shown in the table on the preceding page. (Purely arbitrary figures are used, for clearness).

EVOLUTION OF THE BETTER METHODS OF ELECTRICAL CONSTRUCTION.

By W. J. Canada.

At the beginnings of electric wiring for commercial applications of electricity within buildings, novelty did much more than the degree of convenience then securable, to bring about a considerable use of electric light. With no previous experience as a guide, and in the usual belief among electrical men at that time, that 50 or 100 volts required only reasonable insulation to avoid the few expected casualties possible in interior wiring, the boring of joists was commonly considered sufficient precaution for even bare wire, and the slotting of joists and laying of floors directly against wires was also considered good usage. The fuse wire was generally believed to be no hazard because it was expected to heat only by emergency which would destroy it as a heat producer. Conveniently made wooden blocks were the usual support for these safety appliances. Fittings gradually appeared, mostly wood at first, and some insulation was employed, but support and separation were not at first considered.

Fires directly attributable to the new lighting method aroused the attention of fire-insurance authorities, and by ready analysis, the particular set of fire causes in wiring were ruled out for future installations in that particular district. The variation of rulings in different districts became a serious embarrassment to the expansion of the sturdy electrical industry, and a National Electrical Code was therefore put into use about 1897, through the co-operation of the manufacturing, installing, serving and insuring interests, this Code being directed toward the elimination of bad practice wherever a feasible good practice could be substituted.

By that time, however, the mystery always surrounding electrical uses had established a connection with the mystery often surrounding fire origins. In either case it is mostly a matter of deduction as to the ultimate cause. It became very easy, and much better sounding, in a report on a fire for a newspaper to give "crossed electric wires" as the origin, rather than to state that no indications pointed to any particular cause.

With the quite rapid decrease in the fire rate by electricity, following the establishment of a National Electric Code, and its adoption by the various associations of underwriters, and, more gradually, by municipalities, too, the tendency to assign some cause to a fire of mysterious origin no doubt was responsible for much of the blackness of reputation under which electric wiring still advanced. The degree of co-operation toward safe wiring, by all interests concerned, has been, however, in spite of some purely local irritations, by far the most thorough and effective that has been applied to any source of fire hazard. In the face of the greatly reduced number of proven electrical fires, the tendency to assign those of unknown origin to electricity has also grown less.

Today the reputation of electricity as a safe medium for illumination and power in buildings is really established, not only with insurance companies which can prove this security from their records, but by municipalities and the general public, whose convictions determine their degree of receptivity toward public service. This confidence in electric-wiring safety, while fully shared by the electric service companies and their associations, has fortunately not been made the base, as in some other portions of building construction, for seeking some intermediate construction, which with considerably less cost, would also give considerably less safety. The past experience has shown so well that a betterment pays its cost increase several times over in reduced fire hazard, that any known cheapening method would be expected to lose its saving several times in greater contributions to the total fire loss of the community.

While cost of the installation is matter for constant study, the change which improves safety without excessive cost increase is always acceptable to the service company which builds much of its patronage on the safety of its product. The depreciation of wiring of modern installation is so small that interest alone figures strongly in the average building to offset, from the purely commercial view, lower fire hazard and lower insurance.

Three main features of electrical construction are mostly responsible for fire-hazard minimization, as well as the equally advantageous reduction of depreciation by deterioration and mechanical interference which they also procure. The use of iron conduit as a runway for wires in buildings of fire-resistant construction was an early development, introduced in order to avoid the damage to decorative schemes by open wires. Later practice improved this conduit by providing it with tough, smooth insulating interior coating, though the lining formerly much in use has been mostly eliminated in modern practice. We have also developed good fittings—boxes for concealed conduit and condulets for open construction. But the essential feature of mechanical protection to the wires, electrical protection from them, and permanent accessibility were embodied in the conduit as it first appeared. Its proper use has almost eliminated the formerly frequent arcs between wires of injured insulation, and the fires from this source.

The second revolution in wiring method was the centralization of fuse protection, the making of fuse mountings non-combustible, and finally the inclosure in fireproof cabinets. In the lists of electrical fires of ten years ago a full third were noted as from burning fuse metal on goods, shelves or even wood floors, in spite of the preconceived notion of the safety of the open link from such effects. The inclosure of the fuse in a casing gave some relief, but the cabinet proved the greater assurance against danger from the readily substituted open link, and the vicissitudes that sometimes occur to even the best inclosed fuses.

The elimination of wood from electrical construction—in fittings, in cabinets, and finally, to a large degree, in the persistent wood molding—has cut off another considerable proportion of electrical fire causes. Such construction lent itself so readily to the holding of dampness, the making of undesigned additions by novices, and the fostering of small arcs in early stages, that their displacement by non-combustible and unreadily tampered with construction met with the general approval as fast as practicable substitutes could be offered.

Today, the fire hazard of new wiring in a majority of the cities and most of the towns of the country may be said to be practically confined to the frailty of flexible cord, as subjecting two wires in intimate contact to all the mechanical and electrical stress constantly occurring from their ordinary use; the frailty of fixtures—poor design, injured insulation, and their position against inflammable walls or ceiling; and the constantly increasing number of heating or small motor appliances, cheerfully placed on already fully loaded circuits, thus necessitating overfusing, and leaving previous devices and themselves inadequately safeguarded. The heating devices in themselves are becoming much safer, but the electric pressing iron is still the parent of many fires, as it is so easy to leave with "heat" on, and it does not cool so rapidly as does the once familiar stove-heated iron.

These remaining hazards are now the causes of three-fourths of all electrical fires in communities where conduit construction or reconstruction

has, by rapid growth and well-conducted electrical inspection, become generally the interior-distribution method. In old wiring installations the worst and earliest defects are more and more rarely found, for their hazard or troublesomeness has been so evident, even in small communities that some better material or method has been substituted. Some few materials and practices still persist with the strength which cheapness or convenience can give. Principal among these will be found the long concealed feed, the lack of main switch, the lack of cabinet, the frequent link fuse, and notably the great number of cord runs and the overloading due to an enormous increase in our standard of artificial illumination.

If either concealed or open wiring is in good condition of insulation, separation, and well supported, the safeguarding of the installation during the reasonable life of such comparatively frail construction may be readily secured by removing the objections noted above—no difficult matter. If insulation, bushings, or supports are poor, it is kindness on the part of an inspection department to urge the replacement by the permanent conduit construction.

Today, besides the general satisfaction, freedom from trouble, permanence and good appearance of conduit wiring methods, the safety of electrical wiring, through a more general adoption of the National Electrical Code than has been the fortune of any other set of regulations, is the most pronounced instance in this country of a fire hazard of serious proportions minimized in the face of our general trait of personal irresponsibility, resulting in ten times the fire rate of any other civilized country.

Our remaining problems of importance seem to be the elimination of flexible cords, the adoption of substantial fixtures, the extension of competent supervision to the smaller towns. The old wiring problem is rapidly solving itself where supervision is good, and rational presentation of old wiring hazards are made to owners of property.

New Wiring Rules in Minneapolis.

Minneapolis has always taken a leading position in the matter of electrical installations, such as prohibiting wooden molding for the past four years, in providing tables for both direct and alternating motor wiring, early extended use of conduit, etc. A newly passed amendatory ordinance, taking effect May 6, will again put that city in a favorable position as regards leadership in fire prevention.

The Minneapolis ordinance as amended will require conduit construction for *all wiring* in the "fire limits;" for all other *concealed* wiring in the city except in single and duplex dwellings outside the fire limits; and for *all open or concealed* wiring in the city in show windows, elevator shafts, unfinished basements, hospitals, hotels and apartment houses, theaters, moving-picture theaters, schools, factories, public buildings, assembly halls or public halls, office buildings, department stores, warehouses, mills, grain elevators, feed stores, stables for more than four animals, public garages, and public automobile repair shops.

The ordinance further provides for the exclusive use of metal fuse cabinets (for some years all fuses have been placed in cabinets); for the use of three-phase motors not exceeding five horsepower to be started without compensators; provides for better protection against personal contact with current in sockets and fixtures placed near grounded or conducting bodies; for the exclusive use of metal in the construction of electric signs, as well as a considerable number of other improvements of lesser importance.

Last January a notice was sent to local electricians providing for 1911 Code rubber-covered wire, on and after July 1, 1912.

Electric Heating Installation for a Large Building.

The application of electric power to the heating of buildings has been carried further in Twin Falls, Idaho, than in any other city in the country. The population of this city is only 6,500, and the reason for its great development along this line is the very low rate which has been offered by the Great Shoshone & Twin Falls Water Power Company, which operates a hydroelectric development on the Snake River.

Up to this time heating units for the sole purpose of heating buildings have been installed in that vicinity to the extent of nearly 1,000 kilowatts, connected load. A six-room house having eight outlets uses from 13 to 15 kilowatts maximum and the cost for a season of eight months is about $70 to $100. A flat rate is made for this business by the power company, ranging from $37 for six months' use of three kilowatts to $625 for eight months' use of 100 kilowatts.

The latter figure represents the largest contract which has yet been signed for this use of electric power, and the contract is for a period of five years. The building containing this installation is known as the Smith-Rice Building, which contains stores and offices on the first floor and Cotillion Hall on the second floor. The current for heating is brought into the building through underground conduit. It is three-phase current at 2,300 volts. The transformer room consists of a brick vault with a metal roof, which entirely separates it from the rest of the structure. Three Westinghouse transformers connected delta-delta are used to transform to 220 volts for heating. The lighting is done with 110 volts, single-phase, a separate transformer being used for this purpose. Heaters made by the American Electrical Heater Company, of Detroit, Mich., are used on the 220-volt leads. The different heating cabinets are fed from the transformer room by means of No. 2 stranded copper conductors, 12 of these being connected in parallel. From the cabinets the current is distributed on single-phase circuits to 40 radiators, the load being equally balanced on the three phases. The owner of the building pays for the heating, and rooms are rented with heat included. This method of heating eliminates the necessity for a janitor or other attendant to look after the heating plant.

Hot water is supplied by a water-tank heater, for which a flat rate of $3 per month is charged. This heater keeps the water continually at the boiling point through automatic control.

Current was first applied to the new building on the afternoon of December 31, 1911, during a wave of extremely cold weather. The building was not yet entirely completed, but the last window sashes were put in on that day and current switched on at 4 p. m. A dance had been scheduled for Cotillion Hall for the evening and by 9 p. m., when the dancers began to assemble, the temperature was found to be very comfortable.

The size of this building is 50 by 120 feet, and the approximate cost of the electrical equipment was $1,000. This does not include the cost of transformers, which were supplied by the power company.

It will be seen that the rate charged for this load is about 0.1 cent per kilowatt-hour if the maximum load were on constantly. This occurs, however, only in the severest weather and the actual use is found to be equivalent to 0.6 cent. This, of course, is an unusually low rate, which could not be secured in localities less favorably situated with respect to water powers, but the installations at Twin Falls have demonstrated the feasibility of electric heating where such a low rate can be obtained.

The heating equipment in the Smith-Rice Building was installed by the Twin Falls Electric Supply Company, of which H. H. Freedheim is manager. Mr. Freedheim also designed both the lighting and the heating system of the building.

LETTER TO THE EDITOR.

Location of the Service Cutout.

To the Editor:

I have just read with great interest the editorial on "Location of Service Cutout," and the accompanying articles in the issue of April 6. I think attention should be called to the fact that the writer of the editorial has, inadvertently doubtless, fallen into the precise error which so many wiremen do, and which causes so much trouble to inspectors. The Code distinctly uses two different expressions. Referring to the service *switch* it reads, "in the nearest *readily* accessible place." Referring to the service *cutout* it says, "in the nearest accessible place."

It is obvious that the intention is that the cutout shall be placed just as near to the point of entrance as it is physically possible to get it and be able to get at it afterward should the service fuses blow; convenience, looks, etc., may influence the location of the *entrance* but not of the cutout. The switch, meter, etc., on the other hand, may be placed where *readily* accessible as in reason they should be, and if necessary the intermediate length of feed be protected by a second set of slightly smaller fuses at the switch.

The rigid enforcing of this distinction will, I believe, obviate the troubles found practically completely. It will be found —at least that is my experience—that a firm stand regarding this point is well worth while, and can be maintained with very little friction indeed. If you fail to distinguish between the two and locate switch and meter at the cutout, there will often be trouble in which will be mixed up, owner, wireman, lighting and power company, inspector and sometimes architect, all or in part in one delirious whirl.

WILLIAM LINCOLN SMITH,
Municipal Electrical Inspector.
Concord, Mass., April 7, 1912.

[Confusion regarding the distinction between the two clauses of the Code referred to, among inspectors and contractors, may be responsible for the fact that the cutout is frequently not placed at the point where the service enters. However this may be, the fact remains and calls for a remedy. The editor consulted the Code when writing the editorial in question, and was particular to quote the exact words "nearest accessible" with respect to the cutout requirement. This expression certainly allows wide latitude to the discretion of the inspector.—EDITOR.]

Exports of Copper.

Copper exports for week ending April 11, 6,870 tons; since April 1, 8,892 tons; same period last year, 8,344 tons.

Contractors' Exhibit at Electric Show.

One of the exhibits that attracted considerable attention at the recent Minneapolis Electric Show was that of the W. O. Hartig Electric Company, electrical contractors of Minneapolis. A view of this exhibit is shown herewith.

It was the aim of the company in making this exhibit to demonstrate the handsome effects that can be obtained with electric illumination, using various colored lamps. In the center of the space was a fountain upon which the light was played. Flashers produced the changing color effects.

The participation of the Hartig Company in the Minneapolis show is a move that could well be emulated by

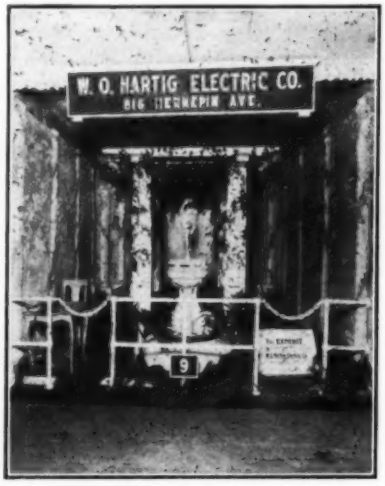


Exhibit of Contractors at Electric Show.

contractors in all parts of the country. Electric shows have become quite common but it is seldom that an electrical contractor is found among those exhibiting. The Hartig company, by its participation, has gained publicity that is worth many times the expense incurred. Progressive policies such as adopted by this company will add greatly to the prestige of electrical contractors.

Advertising in the Contracting Business.

It does not require much investigation to convince one that the really successful electrical contractors are men who have learned the value of good business methods, and who, having learned this, constantly apply this knowledge in the management of their affairs. Many of the more aggressive ones, moreover, know that advertising of a sane sort is almost as essential to success as are good systems of cost-keeping and estimating.

An interesting bit of evidence of the correctness of the foregoing assertion is found in the practice adopted by the Squire Electric & Construction Company, of Kansas City, Mo. Mr. Squire, the manager of this concern, has published a booklet calling attention to some of the bigger and more interesting jobs which his company has done recently. The pamphlet which is of a convenient size for mailing, contains half-tone illustrations of various kinds of installations, and there are brief statements of the company's facilities for electrical-construction undertakings. The list includes office buildings, apartment houses, private residences, complete power plants, and so on, and the locations of the various installations includes several states. The company has found this to be profitable advertising.

Among the Contractors.

The J. W. Turner Improvement Company of Des Moines, Iowa, has been awarded the contract for additional underground work to be done in South Bend, Ind., for the Indiana & Michigan Electric Company. Work is to begin at once.

The Fuller-Coult Company, St. Louis, Mo., has been employed by the City of Cape Girardeau, Mo., to prepare plans for a municipal water works and electric light plant.

Comstock and Company, electrical contractors, of New York City, have been awarded the contract for the electrical work in the new Union Station at Kansas City, Mo.

The Wolfe Electric Company, of Omaha, Neb., is installing the electrical work in the new store of the Brodegard Jewelry Company in that city. The installation includes a complete system of linolite for the show cases together with elaborate window lighting.

The Belden Electric Company, of Joplin, Mo., has just completed the electric wiring in the new post-office buildings at Macon, Mo., and Independence, Kans. The company is now engaged in the installation of the electrical equipment of the State Hospital for the Insane at Vinita, Okla.

C. H. Belden is the proprietor and manager of this company. Mr. Belden is an old Thomson-Houston man, having been the superintendent of that company's plant in East St. Louis during the earlier days of electric lighting. He has been in the electrical contracting business at Joplin for twelve years now. In conjunction with this business he conducts a large electrical store, in which lamps, fans, heating devices and various other electrical appliances are handled.

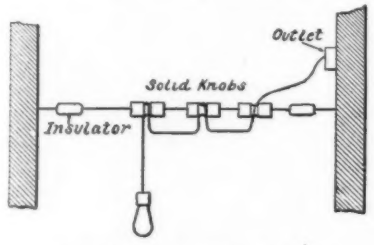
Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Plan for Supporting Portable Light.

On the wiring kink page of your issue of March 23, I noticed a novel way of installing portable lights. I have recently seen an installation which is somewhat like the one described, but which is sufficiently different from it to induce me to offer some account of it here.

It was necessary to have a light over the work bench of a cabinet maker which could be moved along the bench back and forth for some distance. This light was installed in the manner indicated in the accompanying figure. A



Method of Supporting Lamp.

steel wire having solid porcelain knobs strung on it was stretched above the table and parallel with the length of it, the wire being secured to the opposite walls of the room by means of hooks and strain insulators, as shown in the figure. The flexible card to which the lamp was connected was tied to the knobs to keep it out of the way, and the lamp hung from the last or front knob. The lamp itself is equipped with a guard to prevent its being broken, and by slipping the knobs along the wire, it can be moved readily to any necessary position. The arrangement is certainly a very convenient one and I know of no rule to prevent a lamp's being used this way.

N. L. Craig.

Tinning the Soldering Iron.

I noticed in your issue of March 16, an article from *The Telephone Engineer* on "Tinning a Soldering Iron," which seemed to me a rather complicated way of doing it. I have used the following simple method with absolutely perfect results:

File the copper bright and clean and heat in the usual manner. Place a small quantity of soldering flux and a few pieces of solder, say a couple of inches of wire solder, on an old tin can cover or the bottom of a tin pail; when the copper is hot enough to melt the solder rub it around on top of the tin cover on the solder and flux and you will have a perfectly tinned copper.

C. A. Walbridge.

Low-Voltage Bells on 110-Volt Direct-Current Circuit.

In a certain factory six electric bells are used to signal the employees to work. The bells are so large and therefore require so much current when they are rung that, when batteries were used for ringing them, there was a great deal of trouble from failures and the necessity of frequent battery renewals. In order to overcome this trouble I took some old arc-lamp resistances and wound enough of this to take eight amperes when connected across a 110-volt line. As the neutral of the three-wire lighting circuit was grounded in the building. I connected it to one side of the resistance and to one side of the bell circuit through a 10-ampere switch, the switch being located in the office as shown in the diagram. I then tapped the other side of the bell circuit, and, after having connected the other end of the resistance to the outside of the line, commenced with the free end of the tap *c* of the bell circuit to feel along the resistance from *o* toward *n*. When the point *n* was reached, it was found that the bells all rang satisfactorily. Hence the tap *c* was permanently connected here. Subsequent measurements showed that there was eight volts between *o* and *n*. This was not enough to burn the contacts on the bells.

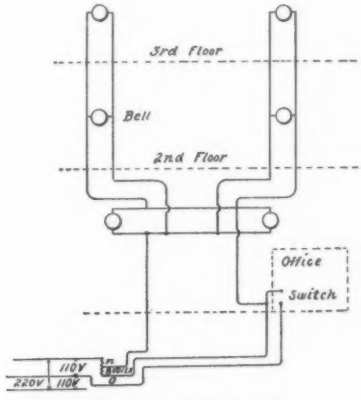


Diagram of Bell Circuit.

Clarence L. Miller.

Improvised Glue Heater.

The glue heater used in our printing department for heating paste burned out the other day, and upon investigation we found that it would take a week to get one to put in its place. So we attached one terminal of the electric circuit to the glue pot, which we placed in a fibre bucket partly filled with water. Into the water we also lowered a piece of sheet iron to which the other terminal of the circuit was attached, a piece of slate being used to keep the sheet iron and the glue pot apart. With this arrangement, it takes only about 20 minutes to get the water to boiling. We allow 20 amperes to flow. The device works very satisfactory, pending the arrival of our new heater.

L. G. Frank.

A Method of Installing Flexible Tubing at Outlets.

I have found the scheme indicated in the accompanying cut a good one to employ while installing flexible tubing at outlets, in wiring already finished buildings. Before the tubing is slipped over the wires a piece is cut out of it as indicated at *n* in the figure, a length being left at either side sufficient for one of the wires. The loom is then bent at this notch and slipped over the conductors as shown in the figure.

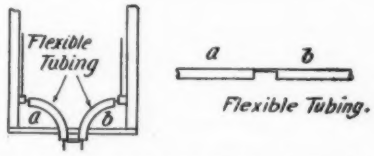


Diagram Showing How Tubing is Installed.

When this has been done there can never be any danger of the flexible tubing working up through the ceiling.

H. J. Bluhm.

Useful Tool for Removing Base-Boards.

For several years I have used floor chisels made of large heavy files. Being in need of some more, I went to a blacksmith to have some made. The blacksmith began looking through his scrap-iron pile and came across half of a heavy buggy spring, which I told him I believed I could use to good advantage. I had the blacksmith draw out the small end and finish it to a chisel point. He was about to straighten it out, and I asked him to leave it curved, as I thought it would answer a good purpose. After having used this little tool I find I can remove base-boards, moldings, etc., with much less damage to them than I was ever able to do without it.

W. A. Hines.

National Electrical Inspectors' Association

THOMAS HENRY DAY, President.
59 Deerfield St., Hartford, Conn.

JAMES BENNETT, Vice-President,
524 Coristine Bldg., Montreal, Que.

WILLIAM LINCOLN SMITH, Sec'y and Treas.,
Concord, Mass.

JAMES E. COLE, National Conference Representative,
11 Wareham St., Boston, Mass.

Executive Committee:

H. S. WYNKOOP, Chairman, 13-21 Park Row, New York

Frank R. Daniel, R. P. Strong, Henry E. Knight, Washington Devereux, James B. McCarthy, Wm. Lincoln Smith, James Bennett, C. W. Mitchell, George L. Collison, T. H. Fritts, James S. Meade, Thos. Henry Day, James E. Cole, Thos. D. McColl

Secretary's Message.

C. H. Fletcher, chief inspector, Vancouver Electrical Department, Vancouver, B. C.; Louis Rosenfield, Superintendent's Office, State, War and Navy Building, Washington, D. C.; Nelson F. Tetro, municipal inspector of wires, Northampton, Mass., have become members of the Association.

On another page of this issue will be found some very interesting correspondence relative to a matter which formed the basis of Question 167 which appeared in the issue of March 2, with supplementary answers in the issue of March 23. Our members will observe that there was a marked variation in the replies received; of the nine answers, five say it is all right, three that the cutout must be changed, and one that it is within the rule but that he personally would call for a change. The correspondence shows that we were not the only ones in doubt. Now if one will read the matter in the Code bearing on the subject, one will see that it is a matter dealt with practically by inference and the information derived from experience as to what may happen on such a circuit. The assumption of course is, three-wire Edison service, grounded neutral and inside 30 amperes in capacity, supplying as one of its branches a two-wire motor service from the outside wires. The sections in the Code on fuses are 1-*d*, 2-*e*, 8-*b*, etc., 19, 23, 38-*d*, 38-*e*, 39-*h* and 85-*m*, and for construction 68-*d* to 68-*k*. Of these the only ones which have any bearing on the question are apparently 23 and 68-*d*. Now in Rule 23 the applicable part is as follows:

"All branches or taps from any three-wire system which are directly connected to lamp sockets or other translating devices, must be run as two-wire circuits if the fuses are omitted in the neutral, or if the difference of potential between the two outside wires is over 250 volts, and both wires of such branch or tap circuits must be protected by proper fuses.

"The above shall apply also to motors, except that small motors may be grouped under the protection of a single set of fuses, provided the rated capacity of the fuses does not exceed six amperes.

* * *

"*f*. Each wire of motor circuits, except on main switchboard or when otherwise subject to competent supervision, must be protected by an *approved* fuse whether automatic overload circuit-breakers are installed or not."

In Rule 68-*f* we have: "Not over 250 volts: 0—30 amperes. *A*. Cartridge fuse (ferrule contact). *B*. Approved plugs for Edison cutouts not exceeding 125 volts, but including 3-wire circuits with grounded neutral and 250 volts between outside wires."

Now in this circuit the only case where the Edison plug could be used lawfully gives us a grounded neutral. The two-wire branch unquestionably requires cartridge fuses. The question then simply is, can the above sections be considered to require the substitution of cartridge fuses for the plugs on the three-wire circuit by implication? The Switch and Cutout Committee has stated that they do and that such substitution must be made. The Secretary is in full accord with the proposition that good engineering requires it, and wishes it clearly understood that the following remarks are simply written to bring out what he has long felt is bound sometime to cause trouble, in cases where the Code is adopted as municipal law without modification. It is true that usually the proviso is added in some form that the Code is law *except in so far as modified (in the lawful manner) by the local authority*, and he would not make this point were it not for the fact that it is sometimes urged that the Code be adopted in its entirety and unchanged. Now in this particular case the Secretary was curious enough to take up the question with a gentleman who would today be a justice of our Superior Court had he not refused the opportunity, and he has stated that in his opinion the court would not sustain the attempt by the municipal inspector to enforce this change. This is not the place to give the legal reasoning of counsel and moreover the Secretary hardly thinks himself capable of doing so; briefly, however, as he understood the matter, the Code would become a kind of contract between the municipality and the contractor and, being written, it is itself the best evidence of its meaning. It definitely states that the plug fuse is approved on such a three-wire circuit, and does not even suggest any reservation where a two-wire tap of this kind is taken off (the motor circuit being protected by proper cartridge fuses) and you cannot consider the three-wire circuit as being a "motor circuit" any more than you could consider it a heating circuit because a flatiron was attached thereto.

Even now, while the decision of the Committee is evidence of the intent of the Code, it is simply its opinion and moreover would very probably be refused admission unless it could be shown that it had been promulgated in such a way that the contractor could be legally charged with notice of it. Briefly the Rules would have to be interpreted like any other stat-

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

ute, and while evidence could be received as to the meaning of the language used, "the language in such a case is not to be enlarged or limited by construction unless its plain meaning requires it."—Wilde, J., 12 Pick, 226; "Courts may give a sensible and reasonable interpretation to such expressions as are obscure; but they have no right to change those which are clear and intelligible."—Parker C. J., 13 Mass., 324.

Of course the case at hand is a small point and one can hardly imagine that it would ever be important enough to cause trouble, so as to lead to a conflict of this kind. Naturally the Secretary has not herein had in mind the method of enforcing the ruling by the insurance authorities, but only by the municipal inspector, and he has written this to illustrate a point which he has long felt might sometime require attention. In his own case he has met it by promptly giving notice of the modified requirement in the manner required by law and sincerely hopes that such will generally be the case with others, as the change is undoubtedly along the lines of good engineering. The point is this, the Secretary feels that as the Code becomes more and more widely adopted as a part of the municipal law, the time is coming when its provisions, in their interrelations and in their expression, should receive attention from the legal side, either as we might say at large, or from the legal department of the municipality.

Another somewhat similar case is illustrated by Question 170 in the issue of April 6. Answer 5, which comes from one of our best authorities, clearly indicates the personal point of view. The whole matter turns on the question of whether the wiring falls under 26-*s* or not. It differs from the former in that it is a question for expert opinion—it is not a question of the meaning of written language, but of whether certain language applies in a particular state of affairs, or certain other language, and would be proved should a legal contest arise by the weight of testimony, expert and otherwise, as in any ordinary case. The two together furnish a beautifully neat illustration of questions to which we as inspectors rarely give attention, but which in fact should receive thoughtful consideration and study.

Running Wooden Molding to Floor.

Question 173. In the case of a straight wooden-molding installation is it proper to accept wood molding to the floor line, or should it stop at the five-foot line and from there on to floor protection as called for in Rule 26-e be provided?

Answer 1. Wooden molding may be extended down to near the floor line, if not exposed to any unusual danger of mechanical injury. We consider that at the floor line this danger always exists, and require a molding protector or kick plate inclosing lower end of molding and heads of floor tubes.

Answer 2. Rules do not specifically cover this class of construction. Wood molding should not be carried continuous to floor line without terminating in some approved fitting for the exclusion of moisture and water due to scrubbing.

Answer 3. This depends upon the use to which a room is to be put; molding with kick plate might be used in a room used for light work; in one where it might easily receive a heavy blow, pipe should be used.

Answer 4. This question is practically the same as Question 172 and the answer given to that question covers in this case. The form of protection on side walls is a matter to be decided in each instance according to conditions, but in some cases the molding would be considered as answering the purpose. The fact that the Underwriters' Laboratories have examined and approved several types of floor and tube protectors for use with the wooden molding indicates that there is a wide use of molding for bringing wires down side walls.

Answer 5. It is purely a question of local conditions.

Answer 6. Under the conditions expressed in this question wooden molding would be approved, care being exercised, however, to properly protect the molding at the floor line with an approved molding box or kick plate.

Answer 7. This apparently at first blush would seem to be a question dependent on local conditions, and the fact that there are kick plates and similar fittings approved by the Laboratories leads to the thought that they have such use in mind.

However, there is a section in the Code which is of interest, Rule 29-*b*. This calls for metal molding to be sheathed in pipe from five feet above the floor to the ceiling below, but "In residences, office buildings and similar locations, where appearance is an essential feature and where the mechanical strength of the molding itself is adequate, this ruling may be modified to require the protecting piping from the ceiling below to a point at least three inches above the floor."

Now if this is thought necessary for the protection of the comparatively rigid metal molding, does it not suggest that the more fragile and permeable wooden molding requires better protection against water than the kick plate? I think it does and that the molding with kick plate is not sufficient except where no wash water is to be feared.

Answer 8. The rules do not contemplate this sort of construction; molding meeting porcelain tubes at floor line is very bad even if shielded by a mechanical protector. We think that pipe should be used inclosing the molding for several inches, or ending a few inches up in a condulet-type fitting against which the molding closely abuts.

Position of First Knob on a Branch.

Question 174. In exposed knob or cleat work, in case a branch is tapped from a line (a) by a soldered tap; or (b) through a branch cutout; how close to the main line should the first insulating support in the branch circuit be placed?

Answer 1. The requirement of Rule 26-*h* for rigid supporting, but more particularly the necessity for a neat and workmanlike installation, would call for supports within a few inches of the point where branch is connected to the main line. It is usual to install the first support about one inch from the nearest wire where it may serve both as a stop for the ordinary three-inch crossing tube, and as a strain relief for the connection to the main line. The same considerations would also require supports within two or three inches of any connection made to the binding screws, switches, cutouts, etc.

Answer 2. There is no expressed distance for such support in the rule. Experience and practice, however, has suggested the wisdom of placing such support close to the cutout or splice that both may be relieved of any strain which might loosen the screw in the cutout or pull the tap wire from the splice.

Answer 3. Where a soldered tap is made, a knob should be in the main line at the tap. Where a branch cutout is used, the first knob on the branch circuit should be within twelve inches of the cutout, as required for dead-ending at a rosette.

Answer 4. In either case the first insulating support should be placed close to the main line (1) to secure

a rigid separation between the wires, and (2) to serve as an anchor, thereby removing the strain from the main line, splices, or cutout terminals.

Answer 5. First support should be within a *reasonable* distance of branch taps or cutouts so as to remove all strain from connection or contact. The distance should be such that the stiffness of wire would support itself independently of connection in event same was removed.

Answer 6. This is a matter of personal judgment, not being prescribed by any Code ruling. Our practice is to place the first support not farther than two inches from cutout or tap.

Answer 7. Within an inch or two if branch cutout is used. Close to the end of the tubes if no cutout is installed.

Answer 8. In case (a), on the main line close to the tap and on the branch not more than three inches away; in case (b), close to the cutout so as to expand the wires promptly to the standard separation under Rule 26-h. This is a point which we have very frequently found neglected.

Public Service Commissions

NEW YORK.

The Public Service Commission, Second District, has denied the application of the Oswego River Power Transmission Company for permission to furnish electricity for light, heat and power in the city of Fulton, Oswego County. Before denying the application of the new company which proposed to bring Niagara power into Fulton, the Commission required the company now serving that city, the Fulton Light, Heat and Power Company, to agree to a reduction in the price of arc lamps for street lighting from $75 to $65 per year for a period of five years, unless the price be increased with the authority or consent of the common council or the mayor or through legally constituted authorities of the city of Fulton or with the consent of the Commission. The Fulton Light, Heat and Power Company has also stipulated that on and after the first day of May, 1912, it will offer for sale and undertake to sell to all applicants, electricity for power purposes in the city of Fulton upon the same terms as to price and under the same or equivalent conditions as to service that are afforded by the company which proposed to compete in that city.

The Commission has received an informal complaint from the Postal Telegraph-Cable Company directed against the New York Telephone Company, alleging that the latter company is wrongfully and by illegal discrimination diverting to the Western Union Telegraph Company telegrams which are intended for the Postal Telegraph-Cable Company. A large number of instances occurring at New York, Rochester, Poughkeepsie, Schenectady, Ithaca, Brooklyn, North Tonawanda, Albany and Gloversville are given.

The application of the New York Central and Hudson River Railroad Company to acquire a majority of the stock of the New York, Ontario and Western Railway Company has been denied by the Public Service Commission. The reasons for the denial are: (1) No transfer of a bare majority interest from the New Haven to the Central should be permitted without reasonably guarding the minority from possible oppression by the majority interest. No means are apparent by which this can be done except by imposing as a condition of the authorization that the Central shall take over such of the minority stock as may be offered it upon the same terms per share as it pays the New Haven. If the minority stockholders availed themselves of this privilege it would make a purchase price to be paid by the Central of substantially $26,000,000 and involve an annual fixed charge for interest of substantially $1,150,000. The Commission is unwilling to impose this burden upon the Central and has had its attention called to no advantage which in its judgment would compensate for the disadvantages involved in such an investment. (2) The continued successful development of the capabilities of the Ontario and Western requires close attention to and careful study of traffic, operating and financial conditions. It is the clear judgment of the Commission that the energies of the Central and its credit resources of every nature should properly be devoted to the public duties and burdens with which it is now charged and to the urgently demanded solution of the numerous and complicated problems pressing upon it in connection with the proper growth and development of its existing properties.

The New York Central asked for authorization to purchase all of the capital stock owned by the New Haven, agreeing to pay the sum of $13,108,397.62 by issuing its 50-year debenture bonds for that amount bearing $583,332 interest, payable annually. The price agreed to be paid is practically 44.94 per cent of the par value of the stock involved. The Commission calls attention to the fact that the New Haven owns a bare majority of the total stock issued, namely, $29,164,000, as against a minority interest of $28,953,983. For several years the Ontario and Western has been paying two-per-cent dividends upon its common stock and six per cent on preferred stock, which amounts to the precise sum which it proposed to pay upon its debenture bonds to be issued in payment for the stock.

In deciding the case the Commission says that it took into consideration the protection of the rights of minority stockholders, the control of a comparatively small railroad by a great system which is to some extent competitive, and which has to some extent intimate traffic relations with it, possible elimination of competition by the practical control and absorption of the competing line, and the effect upon the Central itself, which may be anticipated from the assumption of new responsibilities and liabilities.

As to the rights of the minority stockholders, the opinion states: (a) that the proposed purchase is at a price somewhat above the present market value of the stock; (b) that the stock proposed to be purchased is a bare majority of the stock and the purchase is apparently for the purpose of control only; (c) that the business prospects of the Ontario and Western are not such as to warrant the purchase as an investment; (d) the financial situation of the Central is not such as to warrant the purchase simply as an investment; (e) the condition of the Ontario and Western is such financially that the majority control could easily and without such violation of law as could be prevented by courts oppress

the minority in carrying out the plans of the majority control as to its entire system.

As to the elimination of competition in violation of the so-called anti-trust laws of both the State and United States, the Commission says that it is not essential to enter upon any discussion in view of the other considerations upon which the Commission deems the case should be disposed of.

In March the Public Service Commission tested 34,978 gas meters. Of these 421 were examined on complaint of the consumers. It was found that 45.4 per cent of these were too fast, and 10.5 per cent too slow. The remainder were within the legal amount of variation. Tests of 120 electric meters were made on complaint of consumers, and it was found that 89.2 per cent of these were working properly. Five per cent were too fast and 5.8 per cent too slow.

WASHINGTON.

The first annual report of the Public Service Commission has appeared. This commission was created last year and supersedes the old Railroad Commission, and has jurisdiction over all public utilities. Its activities are still largely with the railroads of the state, although a number of matters pertaining to other utilities have come up during the year. The appraisals of the properties of a number of utilities have been completed and others are under way.

In the Puget Sound Electric case, the decision of the Commission that seven per cent upon a fair valuation of the company's property was a remunerative return, has been sustained by the Supreme Court. The court also agreed with the Commission that the value of the service to the patron was a fundamental consideration in rate-making.

The Commission will shortly adopt official rules governing the sale and distribution of water, gas, electric power and telephone service, for the purpose of eliminating discrimination and improving service. The examination of meters will also be undertaken. The preparation of standard accounting systems for all utilities is under way.

The report covers 292 pages and includes orders and rulings in a large number of cases, mostly involving railroad companies.

INDIANA.

In line with the general movement throughout the country toward a more vigorous enforcement of railroad safety-appliance laws. the Indiana State Railroad Commission has issued a general circular to all interurban roads of the state, advising them to organize immediately safety committees among their officials and employees.

Fuses for Motor Circuits.

One of the questions which appeared recently in the section devoted to the National Electrical Inspectors' Association was as follows:

"Would it be in accordance with the rules to take a 220-volt motor circuit off of a three-wire 110-220-volt feeder that is fused with a three-wire Edison-plug cutout, the motor being properly protected with a cartridge-fuse cutout; or should the three-wire plug-fuse cutout be changed to a three-wire cartridge-fuse cutout? It is understood that in either case the wires are properly protected as regards the size of fuses."

This question was submitted by E. J. Stewart, electrical inspector for the city of Topeka, Kans., and was inspired by the fact that the question had previously been submitted to the secretary of the Electrical Committee of the National Fire Protection Association, who gave an opinion indicating that the use of the Edison-plug cutout under the circumstances of this case was not contrary to the provisions of the National Electrical Code.

Howard Campbell, electrical inspector of the Kansas Inspection and Fire Protection Office, did not concur in this interpretation of the Code, and consequently the following letter was addressed to the secretary of the Electrical Committee.

Topeka, Kans., Feb. 14, 1912.

Mr. Ralph Sweetland, Sec'y, Elec. Com. of the National Fire Protection Ass'n, 141 Milk St., Boston, Mass.

Dear Sir:

Our City Electrical Inspector, Mr. E. J. Stewart, has just shown us a letter from you, under date of February 8, 1912, which appears to show that you would approve the use of Edison three-wire service with grounded neutral with 220 volts between the outside wires, as shown in the enclosed diagram.

Thinking you did not clearly understand his question, we are taking the liberty of addressing you, as we believe that his approval of Edison plug fuses, under these circumstances, based on the apparent meaning of your letter, would introduce non-code practices into our community. We would not approve the use of Edison plug fuses, either for the service fuses, or for the 220-volt motor branch, which is tapped off from the outside wires of the 220-110-volt, three-wire system. We base our ruling on Rule 68-*f*, which, under the first group, Section B, approves the use of Edison plugs on "three-wire circuit with grounded neutral, and 250 volts between outside wires." The use of the word "circuits" would appear to limit this use to "circuits" with grounded neutral, and not the entire "systems."

We believe your statement that these would have only 110 volts impressed on them in case of a ground, would be correct, and if this were the only consideration, these plugs could be approved for such use, under the spirit of this rule.

We disagree with your statement that the fact that the two fuses would be in series in case of a short-circuit, would permit of their approval under this rule. as we believe that this is clearly forbidden by Rule 68-*f*. Only in rare cases would both fuses blow, which would be necessary to limit the voltage broken at the fuses to 110 volts. In practically all cases only one fuse would blow, and the voltage broken would be 220 volts, and in a large number of cases the arcing, especially on the direct-current system used in our town, would destroy the plug, and it would be entirely possible for it to fail to properly protect the motor. Rule 68-*k*, which specifies the test which these fuses must stand, would appear to bear us out in this interpretation.

Trusting we have made our viewpoint clear, and that you will agree with us; and believing that your letter was written under a misapprehension, we are

Very truly yours,
Charles E. Eldridge.

Reference to our issues of March 2 and March 23 will show that the answers to Question 167 were not in harmony, but were almost equally divided between approval and disapproval of the use of the Edison-plug cutout in such a case.

As a result of this correspondence the matter was referred to the Switch and Cutout Committee, appointed by the Electrical Committee of the National Fire Protection Association. The result of its consideration of the matter was indicated in the following letter.

141 Milk Street, Boston, March 12, 1912.

Kansas Inspection & Fire Prevention Office, Charles E. Eldridge, Proprietor & Manager, 701 Shawnee Fire Bldg., Topeka, Kans.

Dear Sir:

Referring again to your favor of February 14, in reference to plug fuses on 220-volt three-wire circuits with grounded neutrals, I beg to advise that the matter has been considered by the Switch & Cutout Committee appointed by the Electrical Committee.

Their decision in the matter is that where two-wire motor circuits are connected to the outside wires of such a system, such wires should be protected by approved 250-volt fuses.

Very truly yours,
Ralph Sweetland,
Secretary of Electrical Committee.

Further reference to this matter will be found in the message of the secretary of the National Electrical Inspectors' Association, which appears in this issue.

Convention of Missouri Electric Association.

Sixth Annual Meeting, Joplin, April 11, 12 and 13.

The sixth annual convention of the Missouri Electric, Gas, Street Railway and Water Works Association was in session in Joplin, Mo., on April 11, 12 and 13. The headquarters of the convention were at the Connor Hotel, and the attendance, including members and guests, was approximately 160. The program, which was a long and good one, was confined almost entirely to papers on electrical topics, and the discussion of these.

The initial session began with a short executive session, which was followed by an address of welcome from the mayor of the city and an appropriate response to this by J. E. Murray, president of the Association. The first of the technical papers was read by R. A. McGregor, of the Empire District Electric Company, whose headquarters are in Joplin, and the subject treated by Mr. McGregor was "Power Development in the Lead and Zinc District of Southwest Missouri."

It was explained that the demands for power for mining operations in the section in questions are large and varied. Mines using other power than electricity depend upon ordinary tubular boilers, steam or gas engines, steam hoists and duplex steam pumps. Gas, supplemented in cold weather with oil, is generally employed as boiler fuel. This gas costs 12.5 cents per 1,000 cubic feet, while gas of the kind needed to operate gas engines sells for 25 cents here. Where coal is used it costs from $1.68 to $2.75 per ton, including haulage. Even under such conditions as these, the Empire District Company, it was stated, had no trouble in producing better economies for mine operation by means of electric drive than are obtained when other power than electricity is employed. A corps of men are employed regularly in selling power to the mines, and they are increasing the load connected to the company's lines at the rate of about 1,000 horsepower per month.

The new-business department of the Empire District Electric Company consists of the man in charge, three men who devote their entire time to selling mine power, one man who handles industrial power in the various cities and towns served by the company, and an engineer whose duty it is to make tests on engines, pumps, compressors and other machinery. The company has considerable business paying $100 per kilowatt per year on the installation. The parts of the mining business which interest the electric company are pumping the water out of the mines, furnishing air for drills to break out the dirt, and hoisting the dirt to the surface where the ore is separated from it.

Steam pumps such as are used in mining are very inefficient, since the steam usually has to be piped 300 feet or further. A test recently run on a modern steam-driven pump showed the total cost of power per 1,000 gallons of water pumped to be 4 cents per 100-foot lift, steam being supplied from a boiler fired with gas costing 12.5 cents per 1,000 cubic feet. This unit was replaced with an electrically driven centrifugal pump, after which the cost was 0.83 cent per 1,000 gallons per 100-foot lift.

Relative to the operation of the air compressors used in mining, it was explained that the service is intermittent and the load-factor low. It is not so low, however, as to make the motor load for this work undesirable from the standpoint of the central station.

The paper dealt in considerable detail with the processes of hoisting the dirt from the mines and milling it—that is, separating out the ore. It was shown that the load-factor in hoisting varies between 18 and 55 per cent, when the computation is based on actual working hours.

Coming to the subject of industrial power, Mr. McGregor stated that, except in the mining installations, most of his company's motor service consisted of small machines. It was found advisable, however, to cultivate even the small-motor business. This was an advertisement for the electric company; it promoted good will, and often the user of the small motor was financially interested in mining.

In closing, the speaker said that ability on the part of the electric power salesman to recommend the right motor for any given service, was one of the most important essentials of the industrial salesman's work. He insisted that unless the salesman has the ability to apply motor drive properly he can not accomplish a great deal in the long run, though he be ever so clever in the matter of salesmanship.

Unity-Power-Factor Single-Phase Motor.

F. N. Jewitt read the second paper of the convention, and his theme was the advantages of the single-phase motor in service where the horsepower per motor is small. A new type of single-phase motor was described. This machine has a commutator on the rotating member, and there is an auxiliary winding in the motor stator the functions of which is to compensate for the low power-factor which the machine would otherwise have on light loads. During starting the motor exerts about two times the full-speed torque and takes approximately two and a half times the full-load running current. At the normal rated load the power-factor is about 93 per cent, and the machine will operate at full speed any load that it will start.

The paper discussed at some length the effect of low power-factor on the equipment and revenue of the central station. In illustrating this effect, a case was assumed in which a motor operating at 100 volts took 5 kilowatts of power. At unity power-factor, the current taken by the machine would be 50 amperes; but at a power-factor of 50 per cent 100 amperes would be required. Since the generator, transformer and line capacity would have to be greater in order to run the machine at this low power-factor than would be necessary in the case of unity power-factor, it was argued that the rate per kilowatt-hour should be higher when the power-factor is poor than should be charged for service in which the quantity is more nearly unity.

Coming to the subject of the single-phase versus the three-phase motor, Mr. Jewett exhibited curves to show the saving in transformer installation when the single-phase unit is employed. The one single-phase transformer needed to operate this machine is cheaper and more efficient, he said, than is a three-phase transformer for supplying power to a three-phase motor. If two or three single-phase transformers are to be used with this last machine, the balance in favor of the single-phase unit would be still greater.

It was also explained that the necessary investment in watt-hour meters is less for single-phase than for three-phase distribution.

Referring again to the effect of low power-factor on the central-station service, the paper treated in detail the question of the larger exciting current necessary to keep the line-voltage at the proper value when the power-factor is low.

At the request of the chairman of the convention, Mr. Jewitt's paper was discussed by Messrs. Wurdack and H. B. Shaw. The discussion was very brief, however, and the main point emphasized was that low power-factor does not require any very considerable increase in the capacity of the prime mover which drives the alternator over the capacity needed to operate a load whose power-factor is 100 per cent.

The final address of the first day of the convention, and, withal, one of the

most enjoyable and interesting features of the whole program, was an illustrated talk by Hugh Cooper, the vice-president and chief engineer of the Mississippi River Power Company. Mr. Cooper's remarks were descriptive of the large hydroelectric power plant which his company is now erecting at Keokuk, Ia. As has been noted frequently in the technical press already, water power from the Mississippi River is to be employed here to develop electric energy, and the project is one of the largest of its kind in the country. When the plant now in course of construction is completed, the capacity will be 125,000 electrical horsepower, and sufficient capital has been secured to increase this to 200,000 horsepower.

Mr. Cooper told of the earlier movements toward harnessing the power of the Mississippi at Keokuk, stating that as early as 1848 there had been efforts to raise funds for some such purpose as this. He related his own struggles in securing means to carry out the work now going on, but stated that ample funds had been secured and that the company had no stocks for sale. In financing the undertaking, he sometimes had to wait months for an audience with a capitalist, and on fifty-eight different occasions capitalists to whom he had presented the matter declined to have anything to do with it.

So far as engineering features were concerned, the address dealt mainly with the difficulties encountered in building the dam across the river, and with a description of the dam and power house as these will be when finished. As hydraulic engineer, Mr. Cooper has been engaged in some of the largest work of this kind in the world. Other installations than the one in question include the hydroelectric development at Niagara Falls, and a portion of the work there was given some attention in the paper.

Electric Pumping.

On Friday, the second day of the convention, H. B. Shaw, dean of the engineering schools of the University of Missouri, presented a paper on electric pumping which proved to be one of the most interesting discussions brought before the Association. The paper began with the consideration of the character of the pumping load where electric pumping is employed, and it was explained that this may easily be made off-peak load. In the case of the central station in the small city, a station capacity of 1,000 kilowatts being assumed, Prof. Shaw thought that under average conditions the load-factor of such a plant would probably be 20 per cent and that under such conditions the cost of delivering power at the switchboard would be 4 cents per kilowatt-hour. By raising the load-factor to 40 per cent the cost of power could be reduced to 2.9 cents per kilowatt-hour. Electric pumping offers an opportunity for such an improvement in load-factor.

It was pointed out that electricity meets strong competition in the fields of lighting, heating and cooking, but when it comes to the transmission and distribution of power there is no competitor for electricity. For the transmission and distribution of power by electricity the advantages are—very high efficiency, reliability and convenience and the ease with which electric power may be controlled, measured and safeguarded.

The use of electric motors for driving pumps may be considered from the standpoint of the central station or from that of the user—perhaps a water supply company—with the result of making evident the advantages to each station and user, and these advantages are combined and intensified when the same company furnishes both electricity and water supply.

F. E. Murray,
Retiring President.

From the central-station standpoint, the advantages of pumping as an electric load are that it is generally of some considerable amount, fairly steady, and by storage, as in elevated tanks or standpipes, can be controlled so as to be off-peak. Measurements can be made easily and accurately with comparatively inexpensive instruments.

As an example of the effect of pumping may be cited the case of the Northern Colorado Power Company, which developed electric irrigation pumping to such an extent that its station output in summer months was greater than in winter months and had lower peaks.

From the standpoint of the user the advantages are reliability, convenience and low cost, both first cost and operating expenses, and reduction of labor costs in certain cases.

Two types of pumps may be considered for driving by electric motors, the plunger type in its various forms and the centrifugal type in several forms differing only slightly. Usually the plunger type considered would be triplex and either single or double acting.

The plunger type has the advantage of being a little more efficient than the centrifugal, but it is essentially a low speed machine, limited to thirty revolutions per minute or thereabouts. It therefore requires speed reduction, as by gearing for connection to driving motor thus increasing cost and adding complexity.

The centrifugal pump, on the other hand, is suitable for direct connection to motors operating at their normally high speeds, up to say 1,500 revolutions per minute. Such pumping units are low in first cost, compact and easily operated. Further, centrifugal pumps are suited to direct-pressure service; that is, they may be used to supply water direct to city mains without requiring a standpipe, which is not true of the plunger type, these requiring by-pass and relief valves as they are naturally constant-quantity pumps when driven by a constant-speed motor.

There have been many improvements in centrifugal pumps within the last few years, and standardized product can be obtained from the best manufacturers, with efficiencies of pump 60 to 70 per cent and over, even in small sizes, and with characteristics suited to direct-pressure service. Motor and pump should be mutually adapted, as there is possibility of danger of overloading the motor when pumping against too low a head. Reducing the head means working on the right-hand portion of the characteristic curve beyond normal rating when the quantity or discharge is greater.

Both types give reliable and satisfactory service under conditions to which they are essentially adaptable; they appear to be remarkably free from troubles, and expense for maintenance and repair low.

The opportunity for measuring power electrically is of advantage in analyzing costs and separating plant wastes.

In the large city pumping stations where the efficient or high-duty pumping units have held the field for years, it is possible that only some exceptional local condition will give the preference to electrically driven pumps; especially is this true since the advent of the steam turbine driven centrifugal.

At Duluth, two steam pumping units, each having a capacity of 5,000,000 gallons per 24 hours, were installed and it became necessary to enlarge the plant. The lowest bid on a 12,000,000-gallon steam pump was $90,000, as against the complete cost of $23,000 of the 13,000,000-gallon electrically driven centrifugal pump which was installed. The motor was 1,000 horsepower three-phase operating at 750 revolutions per minute on a 300-foot head, and the combined efficiency of pump, motor and transformers

was 73 per cent. The cost of pumping by steam was $8.50 per million gallons and by electricity $6.50 per million gallons.

At Buffalo several years ago a 25,000,000-gallon pump was needed and at once. Bids showed cost of electric pump to be $30,000 and cost of steam $125,000. Electric was chosen, and a few months afterward a duplicate was ordered and later a third unit. Apparently first cost as well as low cost of power has influence upon the selection.

In the smaller plants where the inefficient duplex direct-acting steam pumps are in use, considerable improvement in economy can be secured by changing to electric pumping. Assume that the water supply necessary is 300 gallons per minute on the average, at a pressure of 60 pounds per square inch. The water horsepower will average about 10, and with ordinary direct-acting steam pumps the steam consumption will probably approach 150 pounds of steam per delivered horsepower-hour, whereas an electrically driven centrifugal pump, with efficiency as low as 60 per cent, would require a motor input of 16 kilowatts, and the consumption of steam should not exceed 22 pounds of steam per horsepower-hour.

Prof. Shaw's paper closed with an account of some experimental work in deep-well pumping which is being carried on under his direction at the University of Missouri.

Electricity in Rural Districts.

A paper on this subject was read by P. W. Markham, of the Brookfield Gas & Electric Company. Mr. Markham spoke in a general way of the advantages which the farmer may derive from electric service, and recited the experiences of a number of central stations which have undertaken to supply such service on farms. He said that the central station of Elmwood, Ill., has thirty miles of transmission lines supplying eight small towns, and some fifty farmers. They have tapped their 13,200-volt transmission line with 5 and 10-kilowatt transformers, and distribute at 2,200 volts; then standard transformers of 1 to 2 kilowatts are used to feed groups composing of from eight to ten farmers. Poles are paid for, hauled and set by the farmers. Their rates are the same as those used in the towns, with the exception of the minimum charge, which is $2.00 per month instead of $1.00. Flat irons are being used by all of these farmers, and fans and many other small appliances are popular. Small motors are used considerably for pumping.

The Eureka Light Company, of Eureka, Ill., reports a very favorable business among the farmers. Almost all the farmers along the high-tension lines have availed themselves of the opportunity to buy current. Their plan is to furnish and install transformers in convenient places for distribution to several farmers and require them to bear the expense of building the secondary lines to their premises. All farm secondary lines are governed by the specifications of the light company.

The lighting company of Petersburg, Ill., is supplying farmers from its 16,500-volt line, and its policy is to step down to 2,200 volts with a transformer furnished by the company; and then the farmers build the 2,200-volt, line furnishing everything, including transformers, to the point of distribution. The same rates as are used in the towns apply to these farmers, with the exception of the minimum, which is $2.00 instead of $1.00.

There is another case, the Bradford and Gettysburg Electric Company, of Bradford, Ohio, is furnishing the farmers with current at the same rates and the same minimum charge as used in the town, except it adds 50 cents per month additional to the bill to cover transformer losses. In this case the farmers pay for the line.

It might be well to mention the latest development in transformers for rural lines. The manufacturers are now building a line of transformers from 5 kilowatts up to 50 kilowatts to step down direct from high-tension current to 110 or 220 volts. There is an advantage in the use of this transformer; first, the initial cost would be less, and secondly, the core loss would be less.

It seems that the only trouble experienced with these rural lines is caused from lighting; on lines of 6,600 volts or over there will be more or less of this trouble, unless the manufacturers design arresters that will operate satisfactorily for this service, and can be sold at a figure that is not prohibitive.

In the discussion of Mr. Markham's paper, there seemed to be no question as to the profitableness to the farmer of electric service if electricity can be supplied him at the rates charged for city load. The main problem seemed to be one of reaching the farm with lines of the proper voltage.

Herman H. Spohrer, of St. Louis, presented a paper on "Electric Rates," which is abstracted on another page. The discussion of this paper lead to the subject of rate making for electric cooking. G. S. Merrill thought that a demand system of charging is necessary where electric stoves are connected to the central-station lines, but explained that he did not mean that this means should be employed to discourage electric cooking. The subsequent discussion emphasized the belief on the part of the members present that electric cooking should be encouraged by special rates for power.

It is interesting to note in this connection that the electric range had come in for a bit of advertising on the preceding day. Following the lecture by Mr. Cooper, which has already been noted, a representative of the General Electric Company showed a moving picture in which the conveniences of the electric home were brought out in a very convincing and entertaining fashion. The picture began with a portrayal of troubles with the servant growing out of the bad behavior of a coal stove, and depicted the departure from the home of both servant and mother-in-law as a result of the stove episode. In later scenes, the householder was shown engaged in helping the wife with the cooking and the week's washing. But in the midst of this disorder and misery, the electric solicitor comes to the rescue and a complete equipment of domestic electrical appliances are promptly purchased. The picture closed with scenes in the home, to which happiness had at last been assured by the general use of electricity. As an advertising proposition the picture was certainly very much worth while. The wonder is that the new-business departments of the larger central stations do not make frequent use of this plan in pushing the sale of current.

The final paper before the convention was on Liability Insurance, and the author was Lynton T. Block of St. Louis. The paper was a description of the nature and operation of the Utilities Indemnity Exchange of St. Louis. It was explained that this is a co-operative system by means of which the burden on the public utility arising out of accidents to employees is reduced to a minimum. At the conclusion of the paper a number of the central-station men present spoke of the benefits which their own respective companies had derived from the Exchange.

Other Features of the Convention.

The Missouri convention will long be remembered for the pleasing entertainment features which it included, as well as for its technical program. In the evening of the opening day, there was a Rejuvenation of the Sons of Jove, in which a large number of Jovians participated and which was a most pleasing affair. On the following evening, the convention dinner was served, at the Connor Hotel. There were two hundred spreads and not a dull moment from the time Nat Paige, the toastmaster, called upon Judge Hoag, of Joplin, for the first toast, to the time when Sam Bronson, who, by the way, proved himself the humorist of the occasion, pronounced the final word of the evening.

Other speakers at the banquet were President F. E. Murray, of the Missouri Association; R. A. McGregor, of Joplin; N. Cunningham, of Springfield; Stuart Trittle, of Kansas City; Richard Crahan, of Joplin; George E. Hayler, of

Joplin; Clark Craycroft, of Joplin, and Nelson Roth, of St. Louis.

The courtesy and enthusiasm of the Empire District Electric Company and the Southwest Missouri Electric Railroad Company in making the convention enjoyable and successful were especially notable. The former concern, which is an H. L. Doherty property, covers 504 square miles of mining country with its lines and thus supplies power to one of the most important lead and zinc mining districts in the Southwest. George E. Hayler, the manager of the company, and R. A. McGregor, head of the power sales department, are live wires in the electrical industry and they and Judge Hoag, the company's secretary, are equally as energetic and successful when it comes to matters pertaining to a meeting of the kind in question. And the railway just named and its president, A. H. Rogers, proved to be in the same class with the Empire District people.

On the second afternoon of the convention, a trip was provided, on a special train, to one of the Empire District Company's power plants at Riverton, Kansas, and on the following day there was a trip in special cars over through a portion of the mining district in special cars provided by the Southwest Missouri Electric Railway Company. Representatives of the Empire District Company accompanied the excursion to explain the various mining operations. On this trip the convention was the guest of the electric railway company at luncheon served in the company's club rooms in Webb City. Mr. Rogers, the president of the road, acted personally as the host on this occasion, which was truly an enjoyable one.

Officers of the Association.

The officers of the Missouri Electric, Gas, Street Railway and Water Works Association elected for next year are P. A. Bertrand, of Joplin, president; J. E. Harsh, of Joplin, first vice-president; C. L. Cleary, of Sikeston, second vice-president; A. C. Einstein, of St. Louis, third vice-president; and P. W. Markham, of Brookfield, secretary and treasurer. F. E. Murray, who is the retiring president of the Association, J. M. Scott, C. C. Barnard, and J. Woodfill constitute the Executive Committee.

The next annual meeting will be held in Mexico, Mo., in April, 1913.

Convention Notes.

One of the interesting incidents occurring during the sessions of the convention was the adoption of a provision to exclude municipal plants and the managers of them from membership in the Association. At last year's convention, these had been admitted to membership; but it was decided to rescind last year's action.

A bit of work which the Association has undertaken and which it would seem should prove especially valuable to its members is the Question Box which is to be inaugurated now. This will be conducted along the lines followed by the National Electric Light Association.

There was a movement, too, in the convention to secure a larger membership from Missouri in the organization just referred to. At the request of the chairman, A. C. Einstein spoke at one of the sessions concerning the value of the National Association to the central station, and declared that Missouri should have a larger membership in the body.

A Little Recognized Source of Electricity.

If a large drop of mercury be placed on a wide watch crystal and covered with an acidified solution of potassium bichromate, and a clean piece of iron will be placed so that it just touches the edge of the mercury, the drop will draw back from contact with the wire, then swell out to meet it again; after a second contact it again withdraws, and so on indefinitely. It was this curious phenomenon, known as the "beating heart," that started the now famous Professor Lippmann, while yet a student at Heidelberg, upon his investigation of the connection between electricity and capillarity. The best known result of that investigation is an instrument familiar to the laboratory worker of today, the capillary electrometer.

In this instrument the motion of the separating surface between mercury and dilute sulphuric acid is used to measure small electrical pressures. It cannot be used for pressures much larger than one volt on account of the decomposition which would ensue, and consequently its use has been restricted largely to measurements in physical chemistry and animal electricity.

The action of this instrument is dependent upon the same property as the action of the "beating heart," namely, the change of surface tension with electrification. Lippmann was not satisfied with merely showing the relation between these quantities; he proceeded to utilize this relation in the construction of a unique electric motor. This motor consisted of two bundles of capillary glass tubes, each mounted upon one end of a rocker arm, and immersed in a bath of dilute acid, in the bottom of which is mercury. The mercury rose part way in the tubes and was connected by a wire (passing through the acid, but insulated from it) to an automatic switch, which connected the two vessels of mercury to the two poles of a battery and repeatedly reversed them. The rocker arm was connected by a rod to a crank and shaft, carrying a flywheel, so that the vertical motion of the tubes was converted into rotary motion of the shaft. A second crank mounted upon this shaft served, like the eccentric of a steam engine, to operate the switch. When the mercury in one vessel was connected to the negative pole of the battery, the bundle of tubes in this vessel was raised and the other bundle lowered. This motion turned the shaft 180 degrees and caused the switch to reverse the connections. The other mercury was thus connected to the negative pole of the battery and the motion of the tubes reversed. This would be kept up as long as the battery furnished power. The current used was very small, as it was only necessary to polarize the surfaces of the mercury; and Lippmann states that one Daniell cell operated his motor for five days and nights, with an initial velocity of 108 revolutions per minute.

But the most interesting thing about this machine was its reversibility. When the battery was replaced by a galvanometer, and the shaft turned by hand, the galvanometer was deflected, showing that an electric current was generated by the machine. The direction of this current depended upon the direction of rotation of the shaft.

Here then, was a new generator of electricity, depending for its action upon a principle converse to the previous. This principle, that any change in a capillary surface produces a charge of electricity upon that surface, has been almost entirely overlooked by writers upon electrical science.

The Causes of Terrestrial Magnetism.

At the annual general meeting of the Physical Society of London, recently held, Arthur Schuster delivered his presidential address on "A Critical Examination of the Possible Causes of Terrestrial Magnetism." In forming any theory of the cause of terrestrial magnetism the first question was, he said, whether we were to consider the near coincidence of the geographical with the magnetic axis as accidental or significant. The secular variation argued for the second alternative, and scientific opinion had always favored the view that there was a definite reason for the close approach of the magnetic to the geographical pole. The view that iron is responsible for the observed magnetic field has generally been put aside, because iron loses its magnetization at temperatures lower than those which all agree must hold at moderate depths below the surface. But the objection raised on this ground disregards the possibility that the critical temperature of iron might be raised by pressure. It might be shown that if that temperature depended on molecular distance, and the ratio of compressibility to thermal dilatation was assumed to be independent

of pressure, the rate of increase of temperature with the depth was less than the rate of increase of the critical temperature, so that iron would retain its magnetic properties. Experiments on the effects of pressure on the critical temperature of iron have been in progress for four years, but have not hitherto led to a decisive result. For the present we must, therefore, keep our minds open to the possibility that the iron contained in the earth is magnetizable.

Professor Schuster next examined the alternative opinion that electric currents circulating inside the earth are the cause of electric currents. Though this view seems to be favored by scientific opinion, it had to overcome formidable difficulties before it could be accepted. Are the electric currents permanent, or are they only survivals of a former state of things which is dying out? If permanent, we must account for the electromotive forces, and we know of no such forces which could act in the manner required. If the electric currents are survivals, their intensity when the earth crust first formed must have been at least 10^{12} times as strong as it is now, and the difficulty of accounting for their original production would be correspondingly increased. In the opinion of the author, the difficulties which stand in the way of basing terrestrial magnetism on electric currents inside the earth are insurmountable.

The question whether the rotation of the earth might be responsible for its magnetic field was next examined by the author, and different possibilities were considered. If the rotation of a sphere, independently of the chemical nature of the substance, were to produce a magnetic field, it was shown that the field at the surface of the sphere would be proportional to the angular velocity and independent of its size. The effect of rotating bodies set into rotation in our laboratories would give, therefore, magnetic forces equal to those of the earth with one rotation per day, and with angular velocities of the order of one per second the effects would be so large that they could not have escaped detection. A second supposition, that a neutral molecule in its motion behaved as if it carried a charge, led to the result that if terrestrial magnetism be due to such a cause the effects to be expected in any laboratory experiment that could be proposed were far too small to be detected. But the theory was finally negatived by the additional conditions which must be imposed to destroy the effects of translation independently of rotation. A distinction must here be made between possible magnetic effects of a rotatory body on a magnet which was at rest and on one the supports of which were fixed to the rotating body.

Returning to the effects of rotation, the author considered the possibility that rotation instead of directly determining magnetic intensity, determined magnetic force which might or might not cause magnetization according to the nature of the body. This view, he considered, deserved attention, because there was some theoretical foundation for it, inasmuch as molecules might be considered to behave in a manner analogous to that of a gyrostatic compass. The theory would also explain in a natural manner the secular variation by a processional motion of a magnetic molecule. On the other hand, the theory would have to explain why the iron inside the earth became—by rotation—more strongly magnetized than the iron in our laboratories. There was, of course, always the possibility of some substance being subject to the effects of rotation in a much higher degree than iron. Such questions could only be settled by experiments which were now in progress. Other theories of the secular variation were considered.

In conclusion, the question was raised whether the negative electron was subject to gravitation, and if so, whether in comparing the weight of a negative electron with that of the unit positive charge, we must consider the proportionality between gravitation and mass to hold. In Lorentz's theory of gravitation this was abandoned. It was pointed out how fundamental questions had a bearing on the problem of terrestrial magnetism.—*The Mechanical Engineer.*

A Very High Capacity Storage Battery.

Cable dispatches from Copenhagen, Denmark, dated April 13, announce that Prof. H. I. Hannover, president of the Danish Polytechnical High School, who has worked for years on the problem of diminishing the size and weight of electric accumulators and at the same time increasing their capacity, has announced that he has overcome the principal difficulties by the invention of a form of metallic lead containing millions of holes or minute cavities that are invisible except through a powerful microscope. The use of this metal in the manufacture of lead storage batteries will, it is declared, increase their capacity five times without increasing their size or weight.

New York Telephone Meeting.

The Telephone Society of New York will hold its 136th meeting on the evening of April 25 in the Engineering Societies Building, 25 West Thirty-Ninth Street.

An address will be made by R. H. Boggs, division superintendent of traffic in the New York Telephone Company, upon the subject "Some Points of Interest in Traffic Work."

POWER-FACTOR.

By E. J. Edwards.

Central-station men and owners of isolated plants have come more and more to realize the importance of maintaining good power-factor conditions on their circuits. This is evidenced by the fact that many central stations have placed a premium on good-power-factor load by introducing into their system of charging a differential rate, which depends on the average power-factor of the load. Some central stations have fixed a limiting allowable value of 75 to 80 per cent, and consider any load falling below as undesirable. Many isolated plants are operating unsatisfactorily or have been abandoned in favor of central-station service because of a predominance of so-called inductive load on their systems.

The purpose of this article is to call attention to the advantage which the incandescent lamp has over many of its competitors from the standpoint of power-factor.

Power-factor is, of course, the ratio of actual power to the product of volts and amperes, which means that the lower the power-factor, the greater the current necessary to do a given work. A power-factor less than 100 per cent may be brought about by either a lag or lead of current with respect to voltage, but is in most cases due to a lag. The worst offenders in the matter of low lagging-current power-factors are: lightly loaded induction motors, welding transformers, underloaded constant-current transformers, alternating-current mercury-vapor lamps, and alternating-current arc lamps.

A low power-factor such as is most commonly found, that is, one due to lagging current, is undesirable because all electrical apparatus operates less efficiently, greater investment in equipment is necessary for doing the same work, and, perhaps most of all, because good voltage regulation is rendered more difficult where such a load is supplied. For a case of 50-per-cent power-factor, twice the capacity in generators, line and transformers would be required. Therefore the fixed charges, which, by the way, constitute a larger part of the cost of producing electrical energy, would become twice as great. Since the losses in generators and transmission equipment would be greatly increased, the over-all efficiency would become considerably lower. The losses in a given transmission equipment would be four times as great as for 100-per-cent power-factor. The losses in the generator would be more than four times as great because of the additional field current required to maintain the desired voltage. The

regulation of the system would be bad. A generator which will show a change in voltage of only 8 per cent from full load to no load for 100-per-cent power-factor will, for a power-factor of 80 per cent, show a change of more than 20 per cent. Likewise transformers which regulate within one per cent on 100-per-cent power-factor will rarely come within three per cent on 80-per-cent power-factor. The same effect is present in the transmission line, except in degree, which depends on the length and spacing of the line.

It may be argued by the customer that, although it costs the central station more to serve him at a low power-factor, his bill is based on the reading of his watt-hour meter which places no penalty on low power-factor. Such may be the case in his particular instance at the present time, but soon that company will follow the lead of the others and will charge more per kilowatt-hour for low-power-factor service, as it should, because of the higher cost of service. In any event he will receive poorer regulation and therefore less satisfactory service. The customer who has his own plant will arrive at a cost figure much closer to the true value by using as a basis the volt-amperes rather than the watts, and the question of regulation is indeed an exceedingly serious one with him.

It is seen that low power-factor is the enemy of economy of operation and good voltage regulation, the two most important factors, next to continuity of service, in all electrical systems. The incandescent lamp is strictly a 100-per-cent power-factor lamp, the only other being the Nernst, and these possess tremendous advantages over all competitors from the standpoint of power-factor. In choosing an illuminant the question of power-factor of the proposed types of units is therefore worthy of serious consideration.

Power Equipment of the Maverick Mills.

One of the recent noteworthy electrical installations in cotton mills of large size in the United States is that in the Maverick Mills, East Boston, Mass. The initial installation is about one-quarter of the ultimate lay-out. The first section, which has been completed, is a 51,200-spindle mill with a space in the existing buildings for 12,800 additional spindles. Ultimately the mill will operate 250,000 spindles.

The mill buildings are constructed entirely of reinforced concrete and are so designed that the maximum light and ventilation are obtained. That portion which has been completed at the present time consists of a main mill 550 by 130 feet in dimensions, two stories in height; a 340 by 231-foot weave shed one story in height; a 30 by 40-foot two-story detached office building, and a 91 by 62-foot power house adjoining the weave shed.

The power house 91 by 62 feet is of reinforced concrete, divided into two parts by a longitudinal wall. One section is divided into a one-story boiler room, the other a basement and one-story turbine room. Foundation is formed of wooden piles capped with reinforced concrete beams; the foundation of the engine room consists of 22 inches reinforced concrete mattress, foundations for turbine and generators being independent from floor construction. Provision has been made to extend the power house as demand requires.

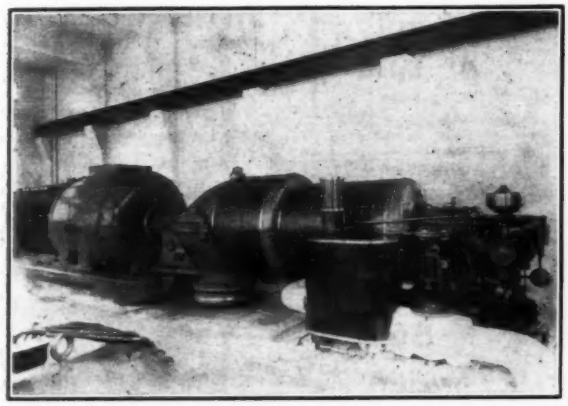
The boiler-room equipment consists of three 400-horsepower Edgemoor water-tube boilers designed to operate at 180-pounds pressure, equipped with Foster superheaters capable of 100 degrees Fahrenheit. In the turbine room there is a 1,500-kilowatt, three-phase, 60-cycle, 600-volt Allis-Chalmers turbo-alternator, complete with engine and motor-driven exciters of 22.5 kilowatts each, together with necessary switchboard. This equipment was furnished by the Allis-Chalmers Company of Milwaukee.

Initial installation of cotton machinery consists of 51,200 spindles, with place for 12,800 additional. The weave shed is equipped with 1,000 Stafford looms, with space for 240 more. The cloth room and repair shop are located on one side of the weave room.

Electric drive is used throughout, the motors being standard three-phase, 60-cycle, 550-volt, induction machines. These are mainly of the ceiling type. The weave shed is driven by four 100-horsepower motors located in the basement on heavy concrete foundations carried on the column footings. There are 20 lines of shafting extending the width of the building divided into four sections of five shafts each. Each motor drives five shafts through a counter pulley.

In the spinning room the four-frame drive is used, a 20-horsepower motor with double pulley on each end driving four frames of 320 spindles each. In place of using a flange on these pulleys, the crowning on each section is 0.25 inch off center. This means that the belt can be kept apart without climbing the flange and being thrown off. Motors in the spinning room are supported in an interesting manner. Bolt holes were left in the concrete girders and wrought-iron plates were tightly bolted to either side of the concrete girders. On these plates were riveted angles to which were attached channels extending from bay to bay, and to these channels the motors are secured. Shafting for the weave shed is carried in ordinary wall hangers bolted to concrete columns.

The mill is under the management of Robert Burgess, whose ideas as regards construction and details have been carried out by Lockwood, Greene & Company, engineers, Boston. The plant was designed and erected by the Hennebique Construction Company. The Allis-Chalmers Company, Milwaukee, Wis., installed the power equipment.



The 1,500-Kilowatt, Condensing Turbogenerator in Maverick Mills.

Two 100-horsepower Alternating-Current Motors Driving Fly Frames.

Dry Cells.

The sixty-second ordinary meeting of the Faraday Society was held on March 26, at the Institution of Electrical Engineers, London, Eng., with Alexander Siemens in the chair. S. W. Melsom, of the National Physical Laboratory, read a paper entitled "Dry Batteries: the Relation between the Incidence of the Discharge and the Relative Capacity of Cells of Different Manufacture."

The paper describes the results of a series of tests made in order to ascertain to what extent the tests in general use afford an indication of the relative value of different types of dry cells. Four types of cell were used for the tests, these being chosen on account of their widely different characteristics.

A number of each of these types were subjected to tests at various rates of discharge. Table I gives the relative values obtained from the tests for each set of cells, taking for purposes of comparison the output of cells A as 100.

TABLE I.
RELATIVE CAPACITY OF CELLS AT VARIOUS RATES OF DISCHARGE.
(The values are in watt-hours, except where otherwise stated.)

No.		Cells. A.	B.	C.	D.
1	5 minutes an hour on 50 ohms	100	93	83	28
2	5 minutes an hour on 1 ohm, initial	100	59	43	7
	After 6 months' storage	100	58	50	—
	After 12 months' storage	100	53	42	—
3	6 hours per day on 5 ohms—				
	Mean of V. B. and V. E. curves	100	50	50	35
4	Continuous at 20 milliamperes—				
	Initial ampere-hours	100	43	36	30
	Initial watt-hours	100	45	40	29
	After 8 months' storage, watt-hours	100	50	45	5
5	Continuous on 10 ohms—				
	Initial to 0.7 volt	100	75	53	60
	Initial to 0.5 volt	100	76	55	60
	After 6 months' storage—				
	To 0.7 volt	100	59	44	28
	After 12 months' storage	100	67	50	2
6	Continuous on 100 ohms	100	68	51	35
7	Continuous on 500 ohms—				
	To 1.3 volt	100	102	87	10
	To end, i. e., 118 weeks	100	94	—	—

Test No. 1 is a near approximation to actual working conditions.

Table II gives the capacity (watt-hours) of the cells at the various rates of discharge.

TABLE II.
RELATION BETWEEN INCIDENCE OF DISCHARGE AND CAPACITY.
(The capacity in each case is given in watt-hours.)

Test No.	Cells. A.	B.	C.	D.
1	43	40	36	12
2	44	26	10	3
3	126	63	63	46
4	105	47	42	31
5	64	49	35	38
6	107	73	55	38
7	70	66	—	—

The results given in Tables I and II indicate that the tests in general use do not afford reliable data as to the relative value of different types of cells or of the actual capacity that may be obtained under working conditions, and it is therefore recommended that the conditions of test should approximate as nearly as possible to actual working conditions.

W. R. Cooper said the difficulty he had experienced was to know exactly when to cut off the current. He had generally used a 10-ampere test and cut off when the voltage had fallen to one-half. A so-called short-circuit test, measuring the current, seemed to be popular in America, but what the short-circuit exactly meant was not specified.

J. Poole thought the author's results would prove very useful to users of dry cells, and he remarked on the importance of having a standard test that could enable a new cell to be put into use after a short time. It was unfortunate that in this respect no satisfactory result was arrived at. He pointed out that the cells included under the author's type D were makes in use some six years ago; types A and B represented the best of the most recent types of cells. Although so very large a number of dry cells, estimated at some 40,000,000, were in use in America, it was noteworthy that the best of them were inferior to the best British types.

Mr. Rawlings said there were many uses for dry cells which were not generally appreciated. For example, he had used them for lighting 15 ten-candlepower lamps in a yacht making a tour in the far North, and after ten months they came back in good condition, having performed their work quite efficiently. It would be interesting to know exactly how long dry cells could be kept in storage; for twelve months they certainly could, and this suggested uses at present overlooked.

J. D. Mackenzie said that suitable tests were required for cells used for bells or lighting, as well as fo telephone use, and he hoped the author would devise some such test. He described an intermittent test that he had devised for comparing two types of cell, which gave an indication that had been confirmed by years of practical use.

E. P. Hollis remarked that some years ago the American Electro-chemical Society appointed a committee to inquire into and report upon tests for dry cells, but up to present only an interim report had been issued, and this was more or less a confession of failure. The author's tests, anyhow, showed the superiority of some cells over others in the case of all the methods of testing employed. It would be desirable, if possible, to test every cell for the particular work for which it would be used.

M. Solomon, in a communication read by the secretary, dwelt on the chaos at present existing in this field. Every buyer seemed to have his own specification, and frequently not only results but even methods of manufacture were specified, an obviously absurd state of affairs. The only merit of many of these specifications was their originality, and it was high time to do away with them all and adopt one standard method of testing. This, however, should be of reasonable duration, and the author's method No. 1, for example, which he considered the most satisfactory, was therefore ruled out as in the case of the A cells it took nearly two years to carry out. He suggested that a modification of method No. 5, where results are obtained in about twenty or thirty days, might be adopted as a standard test, although it would have to be supplemented by another test showing the keeping powers of the various cells.

Alexander Siemens considered a test under actual conditions of working the only real test of the worth of a cell. This could always be applied provided the manufacturer could be relied upon to construct all his cells strictly in conformity with the samples tested.

L. S. Bagster and B. D. Steele communicated a paper entitled "Electrolysis in Liquefied Sulphur Dioxide." The paper describes experiments undertaken with the object of ascertaining the mechanism of electrolysis of solutions in liquefied sulphur dioxide. During the electrolysis of potassium, sodium, tetramethylammonium or trimethylsulphonium iodides, sulphur is deposited on the cathode, a sulphite being simultaneously formed. In the case of potassium iodide, the potassium sulphite which is insoluble in the solvent is deposited on the cathode in quantity nearly corresponding to that demanded by Faraday's law.

At the anode changes occur which are analogous to those occurring in aqueous solution, bromine and iodine being liberated from solutions of bromides and iodides, while anodes of zinc and iron are attacked, the metals passing into solution as complex salts.

It is shown that metals immersed in solutions of their salts in sulphur dioxide have definite electrode potentials, several of which have been measured in saturated solution.

ELECTRODYNAMOMETER INDEPENDENT OF SKIN EFFECT.

By P. G. Agnew and T. T. Fitch.

Conditions to be Fulfilled.

In constructing electrodynamometers it is usual to attempt to get the same current distribution on both alternating and direct current by stranding the windings of the current coils, and in order that each strand shall have the same effective resistance and inductance the strands should also be thoroughly mixed. For heavy currents this becomes a matter of considerable difficulty.

Evidently the ultimate requisite for an alternating-direct-current transfer instrument is that the torque shall be the same on alternating as on direct current. It is immaterial whether we make the current distribution the same, or whether we make the magnetic field due to the current the same. There is no theoretical reason why the current distribution and the magnetic field could not both be allowed to vary if it could be shown that the torque did not change.

One of the authors has described an instrument for very heavy currents in which no attempt was made to avoid differences in current distribution, but in which the magnetic field was independent of differences in current distribution between alternating and direct current.[1] The current "coil" of the instrument consisted of two coaxial copper tubes, capable of carrying 5,000 amperes by passing water through the inner tube. Moving coils are suspended in the space between the tubes. Expressed in the usual terms, there is no field in this space due to the outside tube and the field due to the inside tube is independent of any skin effect since this field is $2I/R$ where I is the total current and R the distance from the axis.

The Toroidal Principle.

Such an arrangement may be easily shown to be only a special case of a much more general principle. Let us consider a generalized toroid such as would be formed by rotating any closed circuit such as A (Fig. 1) about an axis. We may think of the circuit A as consisting of a wire carrying a current, and similarly of the surface of revolution as being a current sheet. Or we may think of the surface as being wound with a layer of wire with no space between turns and thus becoming an endless solenoid.

It has been shown by Maxwell[2] and by Gray[3] that the field, at any point, as at O, is independent of the size, shape and thickness of the conductor and depends only on the total current and the distance of the point from the axis. This may be shown by a very simple process of reasoning. The all-important condition is axial symmetry.

Consider a circle perpendicular to the plane of the paper, and cutting it in the points O and O^1. This circle

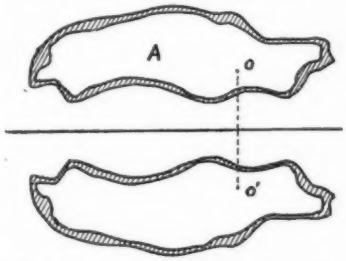


Fig. 1.—The Generalized Toroid.

links once with the current. Hence the line integral of the magnetic field around this circle (or the work required to carry a unit pole around it) is 4π times the total current, or, if we remember that H is uniform around the circle.

$$2\pi R H = 4\pi I$$
$$H = 2I/R$$

The value of H at any point within is thus entirely independent of the dimensions of the conductor *provided there is axial symmetry.* Hence an approximation to such a form for the current coils is admirably adapted for alternating-direct-current transfer dynomometers.

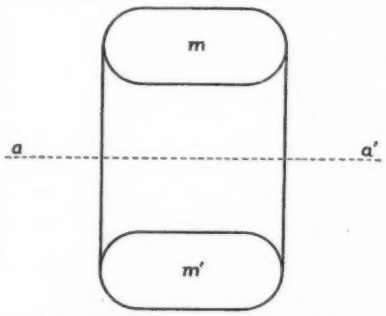


Fig. 2.—Shape of Coil for Instrument.
Moving Coils to be Placed at m, m'.

Windings.

It will be seen that the tubular dynamometer already described is a special case of the toroidal principle in shaping field coils. It is not, however, practical to obtain more than one "turn" so as to adapt it to medium or small currents, and a different arrangement is necessary. The cross section may be made circular as in the ordinary doughnut or anchor ring, but, at least for some purposes, it is better somewhat elongated as shown in Fig. 2. As many turns as is desirable may be wound on such a form, thus making it an endless solenoid. A practical difficulty enters due to there being more room for windings on the outside than on the inside of the ring. The ideal way would be to have a conductor of rectangular section whose width periodically varies so that it would exactly fit the outer surface of the toroid as it is wound on.

The conductor may be wound in a close helix and then bent into the form of an endless solenoid. A refinement would be to make it of two layers on the inside and one layer on the outside. The spiral may also be made from a flat conductor wound edgewise.

Another method is to wind two conductors at once, laying them side by side on the outside and two deep on the inside making the crossings in alternate senses.

It is very convenient to arrange for two moving coils astatically placed in any form of dynamometer whose field coils are arranged on the toroidal, or endless-solenoid principle.

An additional advantage is that the endless solenoid has no external field.

1 P. G. Agnew, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, 58, page 843, 1911. A detailed description will shortly appear in the *Bulletin* of the Bureau of Standards.

2 Electricity and Magnetism, Vol. II, Art. 681.

3 Absolute Measurements, Vol. II, page 278.

Electric Towage.

According to the *Elektrotechnische Zeitschrift,* a two-mile section of the Dortmund-Ems canal has been experimentally equipped for electric traction on an entirely new system. A flexible rail is laid along the bottom of the canal, and anchored so that it is retained in the center of the canal, but can easily be raised to the surface for inspection or repair. The tug boat has an arm with rollers at its end which are driven by an electric motor in the boat, and grip the rail. When the rollers are set in motion the boat pulls itself along, and has shown itself capable of hauling two heavy barges. Power is supplied to the hauling boat from a trolley wire suspended centrally along the canal. The chief advantages are high economy of haulage and no disturbance of the water. The banks are also left free for wharves and other buildings.

Sons of Jove at Joplin.

The exercises incident to the Rejuvenation of the Sons of Jove was one of the especially enjoyable features of the recent convention of the Missouri Electric Association.

M. G. Campbell, of Kansas City, officiated as Statesman-at-Large, and 18 candidates were initiated. Among the other speakers there were J. S. Trittle, A. C. Einstein, R. J. Irvine, P. W. Markham, and S. A. Hobson.

THE WORK OF THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

Address before New York Jovians.

Among the many social gatherings, which are now becoming a part of the life of the man in the electrical trade, probably none is more thoroughly enjoyed than those of the Sons of Jove. Especially is this true of their weekly luncheons in New York City. From 100 to 200 of the fraternity meet at Kalils, Park Place, have a pleasant social hour, and listen to a brief talk from a representative of some organization connected with the electrical trade.

In inaugurating these affairs, Statesman, Frank E. Watts, has and is doing a great deal to bring about that spirit of co-operation which is being so widely spread and sought for among the electrical industry.

Here the competitor of every class and calling is found breaking bread one with the other, forgetting the bitter strife which has tended for years to keep trade conditions upset and in a most chaotic state.

It was at first wondered what use the Jovians would be, aside from furnishing those who were not undergoing the ordeals of an initiatory ceremony, and a good time in general, when a rejuvenation was held.

The other side of the order is now manifest, and it is doing a splendid work. The membership roll is increasing with marvelous strides and is destined to be one of the largest strictly electrical organizations in this country. The luncheon of the New York Jovians on April 3 was especially devoted to the contracting end of the trade, and Marshall L. Barnes, president of the National Electrical Contractors' Association, was the speaker.

In opening his address he spoke of the pleasure he derived personally, as well as the courtesy extended his organization officially, in being the guest of his brother Jovians. He paid a high tribute to the organization and of the great good it was destined to bring to the electrical industry by its composition of engineers, inventors, manufacturers, jobbers and contractors being amalgamated into one great body, all co-operating for one great end, and ever mindful of the motto of the organization, "All Together, All the Time, for Everything Electrical."

Mr. Barnes said that he believed there should be three divisions of the trade as expressed by resolution at the Cleveland convention of the National Contractors, namely, the manufacturer, the jobber or wholesaler, and the contractor or retailer, and that the wholesaler and the retailer should stand religiously by the prices set by the manufacturer, and avoid cutting, and thus embarrassing trade conditions. The contractor looked askance at his competitor before he benefited by organizing, and this was the case in all branches of the business. The growth of the National body, he said, had been most phenomenal in the past eighteen months, the increase being upwards of 100 per cent, and, while a short time ago, the contractor had not really been considered a factor in the electrical trade, today he is looked up to as quite a factor, in his capacity of purchasing some fifty million dollars' worth of supplies, and an immense quantity of machinery. The contractor has at last taken time to stop and look over the situation and figure out the rapid growth of the business, which has literally sprung up in a night, and it was but a step from the door-bell electrician to a full-fledged electrical engineer. Mr. Barnes stated the contractor of the past knew not how to figure, and when he thought 20 per cent a good profit on the cost of material, he failed to give thought to an overhead expense of 25 per cent, and hence he could not meet his obligations and failure was the end. With the advent of organization, the contractor began his rudiments of education, and today, he has credit, a good percentage discounting their bills, and his trade is sought by the manufacturer and jobber.

The National Association issues a monthly publication which goes into the hands of 2,500 contractors. The "Standard Symbols" have been adopted by Government departments and by architects and engineering societies. The "Universal" data and sales book is considered the best for the resale of goods and a wonderful time saver in figuring contracts. This is not only in use by the contractor but by the manufacturer and jobber as well. The new Standard conduit and wiring prints showing conduit from one-half up to four inch, and the number of wires and sizes that can be pulled into these conduits will be of wonderful assistance in figuring conduit installations. The Association has taken no small hand in the code rules and through the efforts of its Underwriters' Committee, these have been simplified and made more effective. Within the year, the contractors' Association has become the friendly ally of the National Electric Lamp, and the National Electric Light Association, and this close alliance has born fruit in the shape of a 40-page publication known as "The Electrical Equipment of the Home," compiled co-operatively by these three bodies. It is without doubt the most valuable guide the architect has ever had for drawing specifications, as well as giving valuable hints to the owner, and has had a circulation of about 100,000. These are but a few of the many good things that the National Association has brought out.

Mr. Barnes called attention to an innovation in the way of cash discounts that he believed would not only benefit the contractor but that would save the manufacturer from losses. As it now stands, the discount is so meager that little attention is paid it, whereas, the contractor would borrow or strain a point to pay for his material within the ten days, if he was allowed a discount of 10 per cent within that time.

The Education of the Electrical Contractor.

The work that the national, state and local contractors' associations have done towards educating the electrical contractors was discussed in an interesting address delivered by C. R. Krieder, of Kohler Brothers, before the Electric Club, of Chicago, on April 11.

The National Electrical Contractors' Association was founded 12 years ago with a total membership of 32. Today the organization comprises 1,200 members. Of the 32 original members. Mr. Krieder stated that 29 still retain their membership and are active in the contracting business. The Illinois Electrical Contractors' Association was organized in 1903, with 23 charter members and today comprises 110 active members, the greater percentage of this increase, however, being made within the past three years.

Mr. Krieder stated that these associations have been of inestimable value to electrical contractors. When I. E. Sanborn, of Indianapolis, was president of the National body he conceived the idea of preparing and furnishing to members, a data and sales book containing information essential to every contractor. This book, which is known as the "Universal Data and Sales Book," has done much to improve conditions in the contracting field.

The average contractor, according to Mr. Krieder, is a man well versed in the practical side of the business but with little or no business experience or knowledge. It has been the aim, therefore, of the various associations to educate their members along those lines, pointing out the necessity of maintaining prices, estimating properly, systematizing office routine and keeping books in accordance with established business practice. In connection with the latter, the Illinois association is at present demonstrating to its members, through an expert, approved bookkeeping methods, which it is hoped will be universally adopted.

In connection with prices of electrical supplies Mr. Krieder thought that contractors should be given better prices than those given to the consumer. He said that it is true that some contractors

are poor risks but a plan that would protect the supply houses and at the same time meet with the approval of the contractors would be to allow a discount of 10 per cent on bills paid within 30 days. This plan has been adopted by a few houses with universal satisfaction.

In concluding, Mr. Krieder spoke of the relationship between central stations and contractors. It has been his experience that the majority of central stations would prefer not to engage in wiring if the local contractors would take the initiative in soliciting residence and other business. At present a joint committee of the National Electrical Contractors' Association and the National Electric Light Association is considering some means of promoting more harmonious relations between the two.

Meeting of the Commercial Division, Commonwealth Edison Section, N. E. L. A.

At the second meeting of the Commercial Division, Commonwealth Edison Section of the National Electric Light Association two papers of vital importance to central stations were presented. The meeting was held on April 16 in the rooms of the Western Society of Engineers. Following several musical selections by the Commonwealth Edison orchestra, Chairman O. R. Hogue called the meeting to order and introduced John W. Ferguson, assistant to the general contract agent, who read a paper entitled "Relations Between the Company and the Public."

Mr. Ferguson pointed out several of the requisites of public-utility employees, the principal one being the duty of the employee to see that the agreement between the company and its customers is faithfully carried out. Ten or twelve years ago central-station men were devoting practically their entire energies to familiarizing themselves with the technical details of central-station operation, neglecting almost entirely the commercial end of the business. Mr. Ferguson said that since this time, however, men of broad policies have taken hold of the management and have developed commercial departments that now form a most important part of the central-station organization.

In no other department is the question of the relations between the company and the public so vital as in the commercial department, where all members come in almost daily contact with customers and prospective customers. Mr. Ferguson spoke briefly of the formality or "red tape" which is necessary in conducting the business of an organization the size of the Commonwealth Edison Company and what effect this has on the feeling of the public towards the company. He said that while "red tape" is necessary it should not affect the harmonious relations with the public if departmental courtesy is maintained. He also referred briefly to the matter of giving customers courteous treatment over the telephone, and conducting business in this manner the same as if dealing in person with the customers.

Speaking of the attitude of the public to the company Mr. Ferguson said that the old feeling of antagonism against public-utility companies was decreasing, due to the good service which these companies are rendering. For the protection of the public, however, Mr. Ferguson favored the state supervision of public utilities, such as is carried out in Wisconsin.

The next paper, entitled "The Electric Vehicle—Its Present Status and Future Possibilities," was presented by R. Macrae, of the contract department. Mr. Macrae briefly traced the development of the electric vehicle from its inception to the present time. The heretofore slow progress of this industry, he said, has been due to lack of attention from central stations. This condition has now changed, however, and wonderful developments are looked forward to. Mr. Macrae presented some interesting figures showing that at present there are in Chicago some 2,500 vehicles of all types. At an average consumption of nine kilowatt-hours per day, with energy at four cents per kilowatt-hour, the company receives a revenue of $750 per day from this business. He stated that there are approximately 90,000 horses in service in Chicago, which number will gradually be decreased by the adoption of electric vehicles. Comparative figures furnished by a user of a five-ton electric truck showed the cost of operation to be $6.00 as compared with $18 as the cost of maintaining three double teams required t do the work now accomplished by the electric. Other figures of a similar character were given.

L. A. Ferguson opened the discussion, emphasizing some of the points brought out in the paper by John W. Ferguson. He said that in the early days of central-station operation the price of energy was of prime importance, while today price is secondary to service. Under present-day operating conditions the employees in the operating department cannot vary the service, but in the commercial departments there are no hard-and-fast rules imposed on the men and it is incumbent on each employee to maintain a high standard of service. Speaking of the attitude of the public toward the Commonwealth Edison Company Mr. Ferguson stated that the harmonious relations that now exist are due in a large measure to the policy of the company to reduce rates as well as improve service.

Speaking of Mr. Macrae's paper, Mr. Ferguson said that in predicting the replacement of the 90,000 horses in Chicago the gasoline vehicle should be given its just merits. He likened the gasoline and electric vehicles to the transmission and distribution systems of a central-station company. He said that the slow development of the electric has been due to the fact that until recently central-station companies did not realize the enormous possibilities of the field.

Ernest Lunn spoke briefly of the advantages of the electric vehicle, stating that its economy, reliability and cleanliness were pre-eminent features.

George H. Jones said that the electric vehicle would receive added impetus this year by the establishment in Chicago of a section of the Electric Vehicle Association of America.

Mr. Walsh presented some statistics showing that the City of Chicago, for the year 1910, collected vehicle tax from 53,476 vehicles. Of this number 800 were motor vehicles.

Peter Junkersfeld called attention to the responsibility that rests upon each employee in carrying out the policies of the company in its relation to the public. He also spoke of the need for accuracy in the work of employees and how carelessness affected their own welfare as well as that of the company.

Illinois Northern Utilities Company Organized.

On April 11 there was incorporated at Springfield, Ill., the Illinois Northern Utilities Company with an initial nominal capital of $1,000. The incorporators are Lewis S. Eaton, Norman K. Anderson and Robert J. Scott, attorneys acting on behalf of interests friendly to the Commonwealth Edison Company, of Chicago. According to newspaper accounts this company has been organized to consolidate various utility companies and water-power privileges along the Rock River in northwestern Illinois. The first properties to be taken over are those at Sterling and Rock Falls, which have been operated by the Sterling Gas & Electric Company. Press accounts state that friendly working agreements will probably be made with the Public Service Company of Northern Illinois and with Tri-City Railway & Light Company, of Rock Island and Moline, Ill., and Davenport, Ia., thus bringing about a community of electric and gas utility interests in northern Illinois.

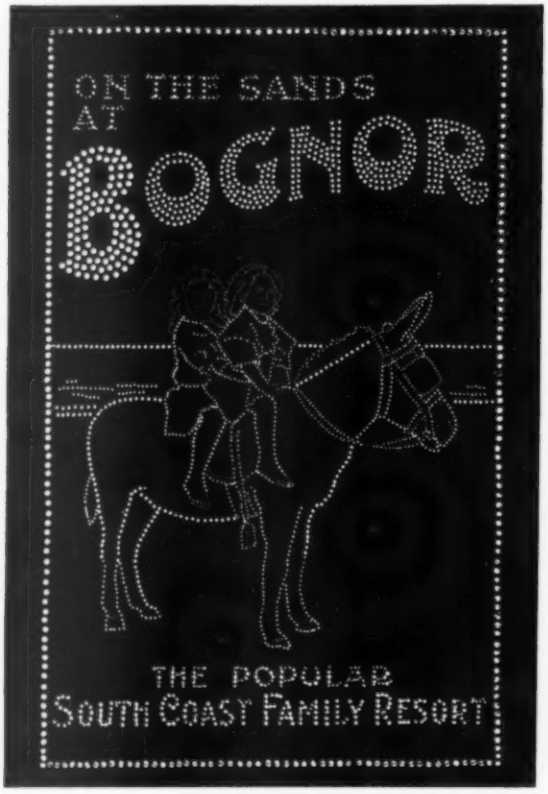
The Electric Sign in England.

Americans visiting the British Isles occasionally remark upon the apparent backwardness of the electric-sign business there. The smallness of the volume of such business has, however, long been recognized and deplored both by electrical supply firms and by lighting companies in England. It is sometimes said in defense, when comparative remarks are made regarding American achievements in the same department, that in actual fact the backwardness is not so real as appears on the surface. Those who admit the lack of progress explain it by a two-fold reason, namely, the untory though its pace has been by no means exciting.

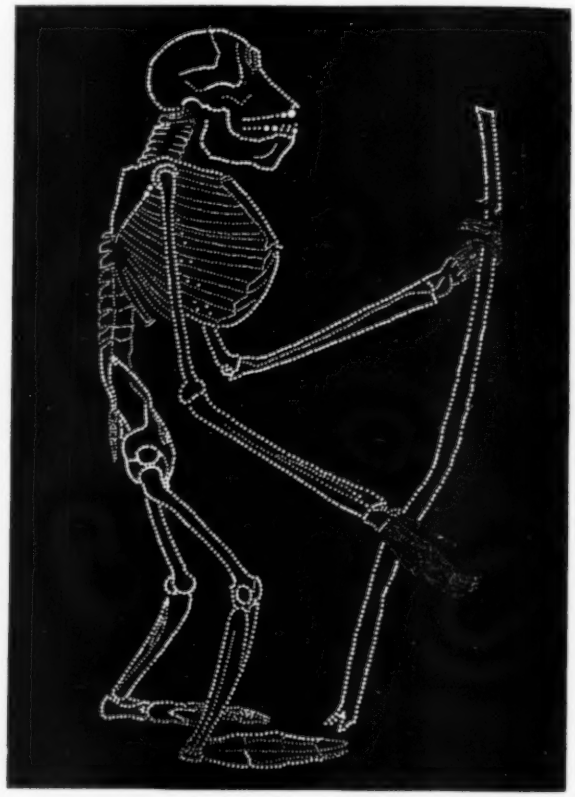
The great success scored by electrical illumination during the coronation celebrations of last June afforded ample evidence of what sign-makers are equal to when the spirit of the right people has been so far stirred as to induce them to tread along a new way. Loyalty and patriotism loosened the purse strings then in manner which twentieth-century business considerations often fail to do with British houses, but it is unquestionable that the electric-sign business has been greatly helped forward by that demonstration, as well as by the one in India

business houses to realize the advantages of electric advertising, and to their unwillingness, when convinced, to pay the price asked "although signs can be produced and fitted in London much more cheaply than signs in America." This authority, however, adds: "There is no doubt that the electric sign in the future is bound to become more and more in evidence."

Another authority dwells with pride and emphasis upon the artistic ability and ingenuity characteristic of recent British sign work, though admitting that there is great room for expansion in volume. The frankness of this critic is



A Typical British Sign.



This Gentleman "Made Signs" to Show What He Wanted.

progressive nature of regulations affecting the use of electric signs, and the unprogressive attitude of the should-be user. But there is now undoubtedly a movement taking place in the right direction, for a number of makers have brought ingenuity conspicuously to bear in the production of effective designs, and the desire of the public entertainment houses, hotels and big business firms in large cities to use electricity to the full, both inside and outside their buildings, has extended to the inclusion of advertising and display signs, fixed, changing, and flashing. To those who have been close observers of the tendency in recent years, the progress of the sign-maker in England, considering all the difficulties, has been very satisfac-

in connection with the durbar, and it goes without saying that wherever these things have impressed the people by their success and grand scale, the position regarding the sign can never be the same as it was before the event.

In the course of some attention recently given to the subject, the writer put questions to certain prominent firms and he has collected a few observations —made of course from the English point of view—which it will be interesting to quote. In one case the opinion is expressed that the backwardness of English firms in adopting electric signs is primarily due to the London County Council restrictions, which do not allow of the installation of roof signs; but it is also ascribed to the failure of English

quite breezy and will no doubt edify American readers:

"My impression is that America is very much behind the times in the matter of signs. We know there is *quantity*, but there is very little *originality* or *quality*. This, I am quite aware, is a big thing to say and it wants evidence to support it, but if I can produce any artistic design in the narrow limits of six feet by four feet, which as in the case of your Chariot Race in New York means the taking of a side of a large house, my contention is not an absolutely empty boast."

Turning now from general considerations to particular examples of British work, mention may be made of one very marked and recent illustration of the ef-

fectiveness of an ingenious design in both advertising an event and demonstrating the utility of the electric method. At Terry's theater, in the Strand, London, two "Franco" signs have been used, in connection with a "Franco" flasher. In the design are a couple of clowns, one of whom throws a number of balls to the other who places them on a table; the second clown then illuminates the word "Cinema" by taking each ball separately from the table and throwing it. When this sign was first set in operation, it so caught the public fancy that the crowds delayed the traffic in the Strand. As a consequence of this, in order to satisfy the police objections, it was necessary for the first fortnight to keep a man in attendance on the roof switching the sign off as soon as a crowd collected. They call it in consequence: "The sign that stopped the traffic in the Strand." The details of this unique sign are as follows: The body portion of the clowns and the tripod are made up with miniature one-candlepower lamps and patent holders, the detail being painted in, and the lamps colored to give the requisite effect. In order to get the best effect for the heads, shaped boxes were made of leaded steel, fitted with glass cut and colored, and illuminated inside with small bulb lamps; the hat is removable for the replacement of lamps. The height of the clowns is eight feet. The balls of the throw on the tripod consist of deep cylindrical reflectors, each fitted with a single lamp. The number of wires from the sign to the flasher was reduced as far as possible, and is only fifty. The Franco flasher which operates this sign is 36 by 18 inches and is worked by a 0.1-horsepower motor and has 52 contacts. The operation begins with the lighting of a lamp in the right clown's hand, travels rapidly across to the second clown, waits an instant in the hand and then extinguishes, one lamp immediately lighting on the tripod. This is repeated ten times until the whole of the lamps are alight on the table. After a slight interval the top lamp of the pyramid is extinguished, and the one in the second clown's hand becomes alight, and after an instant it travels rapidly toward the sign "Cinema" appearing to illuminate a tenth part of this sign. This operation is repeated until all the balls on the table appear to have been taken and the word "Cinema" is fully alight. The whole is then extinguished and it begins again. For this sign there are used 427 one-candlepower lamps, 111 of two candlepower, and 25 of ten candlepower (metal-filament). The consumption is 1.75 units per hour.

The "Franco" signs are being used freely in the west end of London by hotels, theaters, restaurants, electric picture palaces, etc. The system consists of well seasoned hardwood letters fitted with patent watertight porcelain holders wired upon a patent principle, the letters being illuminated by small one or two-candlepower lamps spaced out to give the maximum effect, and in such a way that the light is distributed evenly over the surface of the sign. The number-one signs are fitted with holders to take miniature one-candlepower lamps spaced two to three inches between centers; the number-two signs are fitted with porcelain watertight holders to take two-candlepower small-bulb lamps, spaced three to five inches between centers.

Two Effective Electric Signs Used by British Transportation Companies.

Some examples of signs of a different type are illustrated herewith. They are on the Venner principle and a number of them, prepared as posters for the great railway companies of the United Kingdom, and especially that depicting the gentleman "who made signs to show what he wanted," created a large amount of interest among visitors, electrical and otherwise, at the Electrical Exhibition at Olympia last year. I understand that experience has shown that there is no difficulty in reproducing signs on the Venner principle in the various Indian dialects, in Chinese, etc., which up to the present, it is said, has been regarded as impossible.

New Electrical and Mechanical Appliances

A Scientific Electric Street Lantern.

A doubly unique street-lighting unit has been designd by Vaughn & Meyer, consulting engineers, of Milwaukee, Wis. Historic lines were followed in deciding on the lantern form, but the most modern scientific ideas were incorporated in the equipment. The resulting design is a happy combination of quaint simplicity of outline with highly efficient and satisfactory illumination. The latter is secured by three important features: (1) a tungsten lamp for high-efficiency light production, (2) an extensive prismatic glass reflector for effectively directing the light rays down to the surface of the street and sidewalks to be illuminated, and (3) a cylindrical opal-glass shell to screen the lamp and reflector from view, thus eliminating glare and thoroughly diffusing those rays that reach the eyes of a distant observer. The inclosing shell fits closely about the flaring bottom of the reflector and thus also serves to protect the latter from rain and dust.

Fig. 1.—Electric Street Lantern.

Fig. 1 shows the lantern as mounted on the pole. The lantern design lends itself particularly to bracket suspension. To carry out the rustic effect a plain wrought-iron bracket one-half by two and one-half inches is used. The conical hood is of cast iron and the entire construction of the lantern is of rugged and durable character. Being specially designed for districts where overhead wiring is apt to be used, the circuit wires are brought to the top of the lantern through an iron conduit. The lantern can, however, be also used with underground circuits by a modified form of bracket.

An installation of this equipment was made last winter in Arcadia, Wis., a community of about 1,300 population. The installation was made by the municipality. As shown in Fig. 2, which is a view of the main street, the resulting illumination is very uniform, and there is a complete absence of glare in looking down the street. Although these lamps were placed on one side of the street only, very good light is secured on the opposite side as well. Persons who have driven on the street remark on the ease with which other vehicles and pedestrians can be seen at a great distance. In short, the street is exceptionally well illuminated.

Fig. 2.—Installation of Lanterns in Arcadia, Wis.

The installation in Arcadia consists of 78 lanterns, each containing a 75-watt street series Mazda lamp. The lantern is 16 inches high and is mounted at a height of 15 feet above the street. The prismatic reflector used is Holophane No. 591. A Pheno diffusing globe is used as the outer cylindrical shell. The lamps are entirely screened from view unless one looks up from directly beneath the lantern. A 100-watt point source can also be used with this lantern, if still greater illumination is desired. The lanterns and brackets are made by the Ajax Line Material Works, South Milwaukee, Wis.

Chinese Students of the Telephone in the United States.

For some time past, the eyes of the entire civilized world have been centered upon the political upheavals in China. In the mass of news concerning those disturbances, an incident, which will undoubtedly have a bearing upon the future of the country, is worthy of notice. During the early part of 1911, the authorities of the Government Technical College at Shanghai, or Nan Yang University, as it is now known, feeling the growth of a national telephone system to be assured, took up with the Western Electric Company's representative in China the question of sending a number of the members of the graduating class in electrical engineering, for training in that company's shops.

The necessary arrangements were quickly made and after graduation in July 1911, three men, the first ever sent out by the University for such training, left for America. They came to the Hawthorne plant of the Western Electric Company, at Chicago, Ill., where they are engaged in the practical study of telephony, in the company's student course. Following this, they will spend some time with one of the large operating telephone companies. Upon completion of their studies, the men will return to China, where it is expected that they will be of material assistance in developing the telephone system.

High-Voltage Outdoor Transformers.

There is a steady and growing demand in small towns and in various small industrial plants located near high-voltage transmission lines for outdoor transformers to distribute electric power directly from the high-voltage line. This demand has led to the development of high-voltage outdoor transformers, which is one of the comparatively recent advances in transformer design. There are a great many places where a small amount of power can be sold and yet where it is not economically feasible to install a substation. What is required is a transformer that can be mounted on a platform in any convenient manner, and connected to the transmission line without any special provision for protection from the weather. The accompanying illustrations show Westinghouse transformers designed for operation in this manner.

Fig. 1.—33,000-Volt Outdoor Transformer.

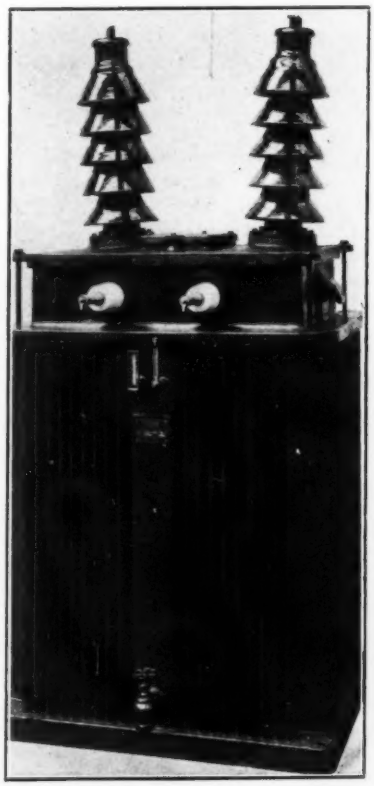


Fig. 2.—53,000-Volt Outdoor Transformer.

Fig. 1 shows a 40-kilowatt transformer for 33,000 volts high tension and 2,200 volts low tension. This transformer is mounted in a case of boiler iron with all seams welded. The low-tension outlet bushings are of corrugated porcelain, while the high-tension bushings are built up of porcelain petticoats. Both sets of bushings are sealed into cast-iron flanges which are bolted to the cover in such a manner as to provide an absolutely watertight joint.

Fig. 2 shows a transformer of a somewhat different design. It is a 100-kilovolt-ampere 53,000-volt transformer. The cases of these transformers have corrugated iron sides, with all seams welded, and the top and bottom are cast on. Substantial cast-iron covers are bolted to the tops. A waterproof gasket is fitted tightly between the cover and case. The material of the sides is absolutely pure iron, not steel, and is very slightly affected by rust. It is further protected by several coats of paint which afford good protection from the weather. The high-tension and low-tension outlet terminals are similar in general design to those shown in Fig. 1 except that the low-tension terminals are brought out on the side instead of upwards through the cover. The construction throughout is very strong and rigid.

Transformers of this type are shipped in accordance with the standard Westinghouse practice of shipping transformers filled with oil. When this is done it is not necessary to dry out the transformer when received, and the trouble and delay caused by assembling transformers in cases and filling with oil are avoided. All the customer has to do in putting the transformer into service, is to remove the blind flanges from the openings to the outlet terminals.

An interesting installation of outdoor-type transformers is shown in Fig. 3, which illustrates three 40-kilowatt, single-phase transformers installed on a float for three-phase service. These transformers were used in the construction of the Los Angeles aqueduct. This method was found very convenient as the float was readily towed from place to place and anchored as the work progressed. Connections were made to an adjacent high-tension line and the voltage was stepped down for use on an electrically operated dredge.

Electric Fans and Baseball Fans.

The James Clark, Jr., Electric Company, Louisville, Ky., took advantage of the opening of the baseball season in that city to install an effective window display featuring Colonial fans, which are handled by the company. The electric fan and the baseball "fan" were used in the window exhibit, a diamond being constructed of the usual material, with sod laid in the most approved style. The base-lines were laid out, and a groove was provided in these in which a light ball was enabled to roll. The motive power was furnished by four fans placed at the home plate and the three bases, the impetus from each being sufficient to carry the ball to the next station. Cut-out photos, enlarged, of baseball players composing the Louisville team, were placed erect at their proper positions, the entire display being unusually realistic, and enabling the company to open its spring campaign for fan business in effective style.

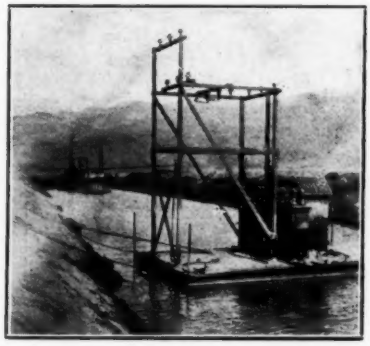


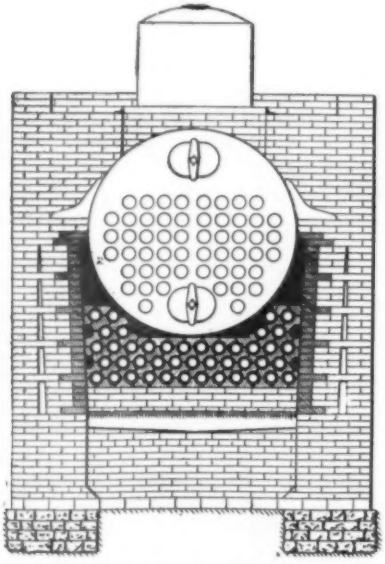
Fig. 3.—Transformers on Float.

A New Device for Preventing Smoke.

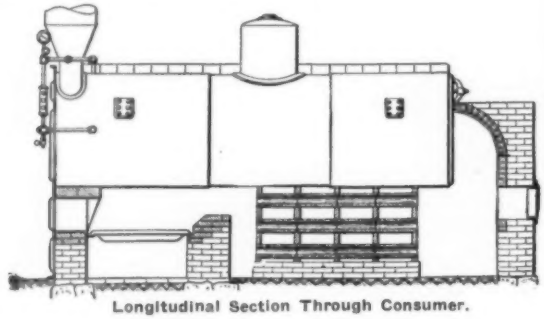
The increasingly stringent requirements of our large cities for keeping down smoke nuisances are calling greater attention to efficient devices for preventing smoke from boiler furnaces. In order to utilize a relatively low-cost fuel, bituminous coals of the poorer grades

are coming into very extensive use. These require either great care in firing or a special construction of the furnace to insure the supply of an adequate amount of air and its elevation to proper combustion temperature.

A furnace-gas consumer recently developed by the Furnace Gas Consumer Company, of Matteawan, N. Y., consists of a series of refractory tubes set in the line of draft at or near the bridge wall in such a way that the gases volatilized by the primary combustion pass through the tubes before reaching the boiler surface. The tubes are placed end to end in five or six lengths. As the passage through the tubes has a cross-sectional area equal to or greater than the area through the boiler flues, the flow of the gasses is not impeded. Since the tubes form continuous passages from end to end, accumulations of dust can easily be blown out. No changes are required in the foundations of the boiler since the tubes utilize the space usually wasted behind the bridge wall.



End Elevation of Furnace-Gas Consumer.



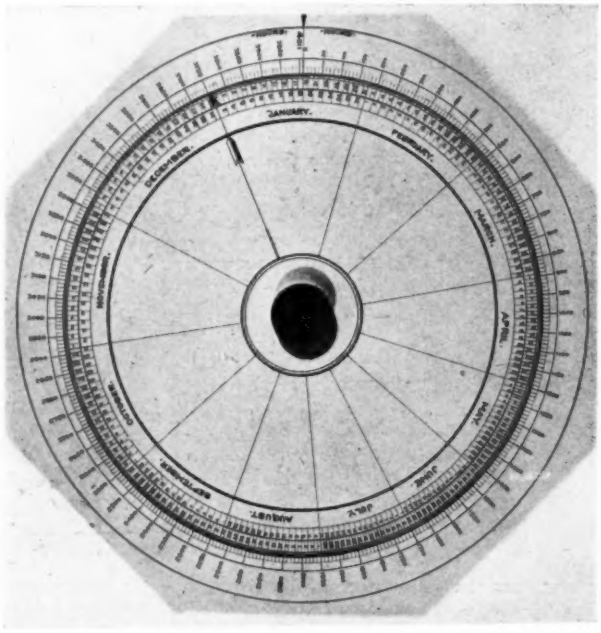
Longitudinal Section Through Consumer.

One of the functions of these tubes is to store heat from the gases liberated by the combustion when the fire is quite hot and to return this heat subsequently to the gases distilled from fresh coal and to the inlet air, thus creating conditions requisite for perfect combustion. The heat-storage value of the tubes is shown by the quickness with which they permit a banked fire to be started up and the high steam pressure attained in a very short time. The tubes also assist in maintaining a more uniform steam pressure, due to their great heat-storage property, which serves to tide over irregularities in the operation of the boiler furnace as well as while the fires are being cleaned. The heat stored under a 100-horsepower boiler is sufficient to operate that boiler at full load for 12 minutes, and is amply sufficient to heat the distilled gases and the air during the short period after each firing. The consumer thus utilizes considerable fuel in the form of unburnt gases, which in ordinary operation escape unconsumed up the stack.

Practical results with this consumer show that the gases issuing from the stack are substantially colorless for at least 95 per cent of the time and only a slight volume of brown smoke is emitted each time that soft coal is spread over the grate. Since better combustion results with less air, higher economy is attained. Greater efficiency of heat absorption by radiation as against heat absorption by convection and conduction results. This produces a better boiler efficiency, since less heat remains to be absorbed from the gases by the boiler tubes. This is equivalent to adding a large amount of boiler heating surface. It also prevents the formation of soot and its subsequent accumulation in the boiler tubes. The accompanying illustrations show the application of the device to a return tubular boiler.

Rapid Computer for Lamp Life.

A scheme for quickly calculating the burning life of incandescent lamps has been devised by the Arc Lamp Department of the New York Edison Company, and was described in a recent issue of the *Edison Weekly*. As shown in the accompanying illustration, the outer scale is fixed and indicates the total burning hours throughout the year on the lamp schedule used in New York City, the number of hours varying from day to day as the season of the year changes The inner scale revolves and indicates the burning time for the different calendar months. By reading off the number of hours between any two dates, the hours of burning for a lamp which is on the circuit during that time is directly given. In the illustration, January 18 is set on the zero mark. Assuming that a lamp was placed in service on that date and was removed on March 5 the burning period would be 600 hours, which is the reading on the scale opposite March 5. This device saves a great deal of time in computing the number of hours of service which have been given by lamps on the street-lighting circuits.



Lamp-Life Computer for Incandescent Street Lamps.

Central Tube Company Enters the Conduit Field.

The Central Tube Company, of Pittsburgh, Pa., manufacturer of wrought merchant pipe, both black and galvanized, with mills at Economy, Pa., announces the manufacture of a complete line of electrical conduit and fittings. The company will make three lines of special conduit under the trade names.

respectively, "Central White," "Central Black," and "Central Red."

Central White is an electro-galvanized conduit made from the company's own brand of especially prepared pipe. The utmost care is taken to thoroughly clean and remove all scale and silicates before giving it a coating of zinc, by a special process in a solution the ingredients of which are a secret. The company claims that this exterior coating is absolutely continuous, free from pinholes, and other objectionable features, and is an absolute preventive of rust, thus insuring against any deterioration of the pipe. Special care is taken that the threading requires no cleaning at the time of use and affords perfect electrical contact. The interior of Central White is covered with a glazed red enamel, presenting a thoroughly smooth runway and permitting electrical wires to be fished with great ease.

Central Black is made from a high grade, mild, wrought pipe, manufactured in the company's plant by its patented process. It is thoroughly cleaned by mechanical and acid treatment, and coated twice both inside and outside with elastic black enamel. The company recommends this pipe especially to contractors and engineers who desire a pipe which is easy to cut, thread and bend. Care is taken to render the thread free from excessive enamel so as to do away with cleaning on the job.

Central Red is a special conduit made for installation where the conditions are especially severe. The pipe is prepared in the same manner as Central White, and over the zinc exterior a coating of red enamel is placed. The interior is the same as standard Central White.

The conduit plant of the company is located adjacent to its pipe mills at Economy. The officers of the company are: Alex. Laughlin, president; T. C. Pease, secretary and treasurer; W. F. Ingals, manager of sales; W. F. Hart, assistant to the president. James H. Rogers has been appointed manager of conduit sales. Earle V. Hennicke, well known throughout the electrical field, is assistant manager of conduit sales.

Battery Switches in Gang Tandem.

The Cutler-Hammer battery switch has heretofore been furnished standard as a single switch or in gangs of two, three and four with plates to suit. However, in some cases recently there has been a desire to mount the switches one above the other and for this reason these battery switches are now furnished in gangs side by side and one above the other as shown in the illustration. The switches in both cases are the same, of the 10-ampere, 80-volt battery type arranged for push and pull operation. Pushing the button opens the circuit. The frames of the individual switches are riveted to a steel connecting link. A solid flush plate, with polished brass, brush brass, polished nickel or gun-metal finish, is fastened with machine screws to the switches after they are installed. These

Cutler-Hammer Battery Switches.

switches are manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

New Appleton Snap-Switch Unilets.

A new line of Unilets has been placed on the market by the Appleton Electric Company, 212 North Jefferson Street, Chicago, These are specially designed for use with snap switches. They are made in six dif-

Appleton Snap-Switch Unilets.

ferent styles, four of which are shown in the illustrations herewith. These snap-switch Unilets are two and one-half inches in diameter, one inch high and made of drawn steel. They will fit all makes of five-ampere and ten-ampere snap switches. They are very neat in appearance and, of course, cannot be broken.

These boxes are also made with covers to fit the standard line of receptacles.

A New Magneto Multiple Switchboard.

It has been announced by the Western Electric Company that, in response to the many requests made for such equipment, its engineers have recently completed the development of a magneto multiple switchboard with a jack for every line within easy reach of each operator. The new switchboard, known as the No. 1013 type, is designed for use on local-battery magneto-telephone systems where, on account of local conditions, a central-battery board would be out of the question.

The No. 1013 switchboard is intended for telephone systems having an ultimate capactiy of 1,500 lines or less and where the traffic conditions make it necessary to take advantage of the inherent rapidity and efficiency of operation obtained with a multiple switchboard. The sections are of the five-panel, two-position type and, when lined up in the operating room, present the appearance of one continuous cabinet. A cable-turning section with a terminal rack is provided for the head end of the switchboard line-up, matching the other sections in design and finish.

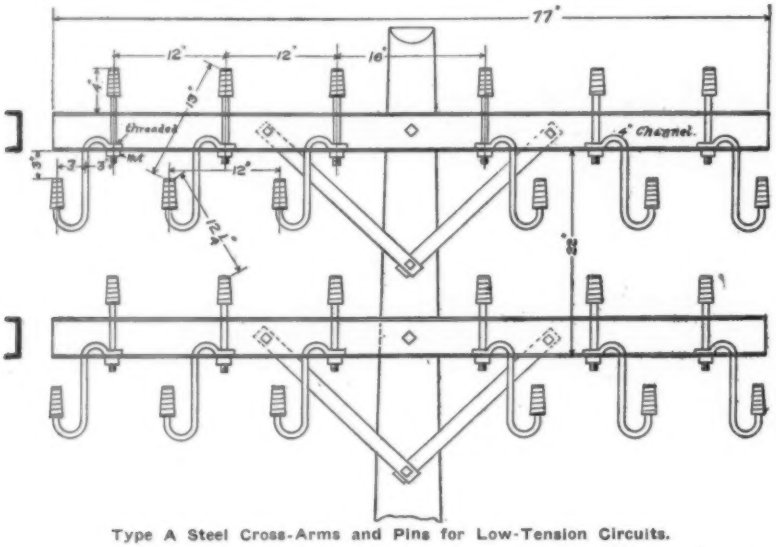
Steel Cross-Arms and Pins.

A line of steel cross-arms with steel or malleable-iron pins has been designed and is being placed on the market by Charles G. Ette, of the St. Louis Malleable Casting Company, St. Louis, Mo. The inventor is a practical foundryman of over 40 years' experience. Of the 40 odd patents granted to him, 18 were secured in the last five years principally on electrical pole and line hardware. Seven patents are now pending on the line of metal cross-arms and pins described herewith. These designs cover both low-tension and high-tension lines.

The standard cross-arms are steel channels with four-inch web and one and five-eighths-inch flanges and weighing 5.25 pounds per foot. A lighter arm weighing about 20 per cent less can also be used, its tensile strength being over 18 times that of wooden cross-arms. Type A pins are designed for telephone and telegraph lines. These pins are made of special one-half-inch steel. Each standard arm carries 12 pins instead of 10 on wood arms. Six of the pins extend above the arm and six below in staggered order. This results in considerable economy of cross-arm material, 60 pins requiring only five 77-inch steel arms against six 120-inch wood arms, the former occupying less vertical pole space also, although greater sagging space is allowed between wires with the steel construction. The weight of five steel arms and 60 steel pins is 206 pounds against 276 pounds for six wood arms and 60 pins.

In the type A construction the upper pin is exactly like the Western Union

steel pin, except that the forged shoulder is dispensed with, with a resulting economy of about 30 per cent in cost. The downwardly projecting pin, into which the upper pin screws between the flanges of the arm, is flattened cold at the top into which a half-inch hole is punched and threaded. The lower end is also threaded and double bent cold. When the upper pin is screwed into the lower one the additional nut under the lower flange acts as a jamb nut, thus reducing its liability to run off; even should it drop off, the pins are still united between the flanges of the arm and cannot drop off the latter. The jamb nut can be dispensed with by slipping a piece of gas pipe on the lower end of the pin and bending the latter about ten degrees. A wood head is put on each pin.

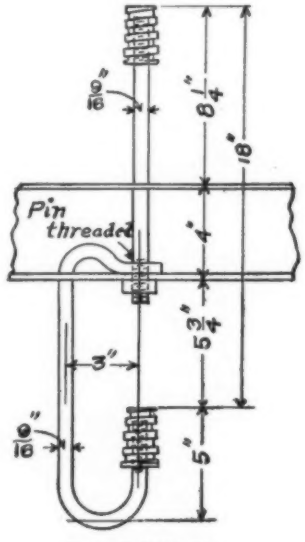


Type A Steel Cross-Arms and Pins for Low-Tension Circuits.

Aside from the lower freight and erection charges, the type A steel arm and pin construction saves from 20 to 33 per cent in the initial cost of material, depending on the kind of wood arm considered. Besides the steel arm will last probably as long as three wood arms. It is easier to wire, as the lineman can reach every pin from the pole without climbing on the arm. It also has 50 per cent less wind surface and imposes a smaller weight on the pole. The Ette construction also provides for ideal transposition of wires, the lower pin being merely bent in the opposite direction, as in the type E pin.

To permit wood arms to be replaced by steel arms without changing the positions of the wires and, in fact, to use the same notches in the pole, the type E pin has been designed. With this arrangement three steel arms take the place of six wood arms of equal length. Type E pins are designed for either 18 or 24-inch vertical spacing between superposed heads. Half-inch or five-eighths-inch pins can be used. The economy of the type E construction over wood arms is even slightly greater than that of the type A construction.

The type K pin is a malleable-iron pin specially designed to be clamped about the arm without requiring the drilling of any holes in the latter. It is particularly suitable for high-tension feeder lines and is very readily applied as the lineman handles but two parts, the hinged casting and the nut. The hinge draws up the pin tightly against all four sides of the arm. The natural spring of the hinge casting near the bottom of the hinge acts as a nut lock. Modified forms of this pin are also designed for angle or T-shaped steel arms, but in any case no holes are drilled in the arm for the type K pin. These pins are made in various lengths and sizes and are specially suitable for feeder arms on iron poles for which a malleable-iron stool and clamp is provided.



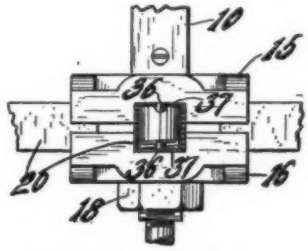
Type E Steel Pin.

New Polacheck Electric Fixtures.

A new line of electric fixtures has been designed and placed on the market by the Charles Polacheck & Brother Company, of Milwaukee, Wis., one of the largest manufacturers and dealers in electric and gas fixtures in the Northwest. In these new fixtures it was aimed to develop a series of designs of simple and inexpensive construction that could be readily adapted to various modifications.

Thus the fixture can easily be made into either a two, three, four or five-arm electrolier. With 36 different fixture parts, including round or square arms, nearly 100 distinct combinations can be made. Simplicity of construction is attained by dispensing with the inner tube usually provided in ordinary fixtures. The stem can be extended by means of a simple coupling, round or square as needed. Generous wiring space is provided through every part of the fixture, including the special clamping device that rigidly holds the arms to the stem. This greatly facilitates assembling and wiring of the fixture so that the work can be quickly done by relatively unskilled labor.

A particularly valuable feature of these fixtures is the patented clamping device referred to. The accompanying diagram shows this as arranged for a four-arm fixture with square stem and arms. In this case the two clamping numbers *15* and *16* are of rectangular shape to correspond with this type of design and the recesses for the arms are rectangular also. Into each recess projects a tooth or lug *36* which fits into an aperture *37* in the arm. The recesses themselves closely fit the arms and the projecting lugs still further prevent the arms from twisting or longitudinal movement. The arms do not have to be threaded or screwed into place. They hold their proper position perfectly, insuring a neat and rigid fixture when assembled. Assembling is very rapidly done because the arms have merely to be put in place between the clamping members and the nut *18* tightened. The entire fixture can therefore be completely assembled before being mounted on the ceiling.



Fixture-Clamping Device.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

SWEA CITY, IOWA.—The city is considering installing an electric light plant. C.

QUASQUETON, IOWA.—P. J. V. Cross will construct an electric light plant here. C.

BLOOMINGTON, WIS.—The Lancaster Electric Company has been granted an electric light franchise here.

KEARNEY, NEB.—This city has voted in favor of a $40,000 bond issue for a municipal electric light plant.

PIERSON, IOWA.—It has been voted to bond the town for $4,500 for the erection of an electric light plant. C.

DURANT, OKLA.—The city has voted in favor of extending its lighting system, at an estimated cost of $5,000.

BATTLE CREEK, NEB.—The Battle Creek Electric Light Company has been incorporated with a capital stock of $25,000.

HAMBURG, ARK.—The city will issue additional bonds for extension of its electric light plant and waterworks.

MURRAY, IOWA.—A movement is on foot to form a stock company to install a $10,000 electric light plant. F. S. Smith is interested. C.

BLACK ROCK, ARK.—The Town Council has granted a 25-year franchise to B. Nichols to construct an electric light plant.

RIALTO, CAL.—Bids will be received until May 21 for the sale of a 50-year franchise for an electric-pole and wire system in the city.

RED WING, MINN.—A new system of arc lights will be installed throughout the city by the Red Wing Gas Light and Power Company.

AMERICUS, GA.—The Americus Power Company has been organized here for the purpose of erecting an electric light and power plant.

DENISON, TEX.—Improvements to cost not less than $10,000 are to be made during the coming summer by the Denison Light & Power Company.

SAVANNAH, GA.—Savannah Power Company has been incorporated with a capital stock of $1,000,000 by George J. Baldwin, Marcy L. Sperry and others.

CORONA, CAL.—The Pacific Light & Power Company has been granted a 50-year franchise to maintain a pole and wire system upon all streets and alleys of this city.

SWEETWATER, TEX. — Sweetwater Light & Power Company has been incorporated with a capital stock of $50,000 by L. L. Stephenson, W. J. Fulwiler and H. G. Carroll.

SHELBYVILLE, TENN.—J. F. Boyd, president of the Duck River Power Company, announces that the company is planning for the construction of hydroelectric plants on Duck River at a cost of $100,000.

CULDESAC, IDAHO.—The City Council is contemplating bonding the town for putting in an electric light plant. The plan is to put a dam across Lapwai Creek, two miles above here.

MAXTON, N. C.—Maxton Light & Power Company has been incorporated with a capital stock of $50,000. The incorporators are J. J. Kincaid, W. M. Kincaid and McKay McKinnon.

ANSON, TEX.—City Water & Light Company has been incorporated with a capital stock of $10,000. The incorporators are A. W. Johnson, J. A. Harris, B. F. Goodwin and J. W. Skinner.

KENDALLVILLE, IND.—The Town Council has employed F. H. Froelich, engineer, to prepare plans for the improvement of the municipal light plant, the estimated cost of which is $35,000. S.

TOWNSEND, MONT.—The municipal light plant has been sold to the Butte Electric & Power Company. The old plant will be discarded and new lines strung throughout the town. C.

SULLIVAN, IND.—The Sullivan Water & Light Company has filed a bond with the mayor for the construction and equipment of a new water and light plant. The contract will be let at once.

ANSON, TEX.—The City Water & Light Company has been organized here with a capital stock of $10,000. The incorporators are A. W. Johnson, J. A. Harris, B. F. Goodwin and J. W. Skinner. D.

BOONEVILLE, KY. — Booneville Light & Power Company has been incorporated by H. C. Combs, T. C. Fuller and C. B. Moore for the purpose of constructing an electric light plant.

ELKTON, MD.—Home Manufacturing, Light & Power Company has been incorporated with a capital stock of $8,500. Bonds in the amount of $50,000 have been issued to cover the cost of erecting a power house, etc.

COLLINSVILLE, CONN. — The Collins Company will build another dam and reservoir on the Farmington River, about a mile below the present works, put in electric generators and bring the power back to the mills by wire.

LEWISTOWN, MONT.—Municipal Power Company has been incorporated with a capital stock of $200,000. The directors are L. H. Hamilton and J. W. Roberts, Great Falls, and Samuel Phillips, Frank F. Goss, D. F. Smith, Lewistown.

WILLOW SPRINGS, MO.—The Light, Power & Manufacturing Company has been incorporated with a capital stock of $20,000. The incorporators are W. T. Wright, W. Bucklow, E. M. Rollins, B. F. Thomas and others.

VALDOSTA, GA.—H. T. Hartman, Land Title Building, Philadelphia, Pa., has purchased the Consolidated Ice & Power Company and it is reported that he will make extensive improvements to the electric light plant and transmission system.

HOUGHTON, MICH.—The Houghton Businessmen's Association and Gardner Rogers, general manager of the traction and electric light companies, have a plan under way for an ornamental system of lighting on Sheldon Street.

RED WING, MINN.—E. J. Peters, of Minneapolis, and John J. Geiger, of Fargo, are promoting the construction of a power plant on the Cannon River, four miles below the one located at Cannon Falls, for the purpose of selling electricity to Red Wing and Rochester. C.

CLARINDA, IOWA.—The Lee Electric Light Company, of this place, has purchased the central station at Corning and will sell the equipment. Power will be furnished from Clarinda to Corning, *via* Gravity by means of a three-phase transmission line 34 miles in length.

MILWAUKEE, WIS.—The County board of supervisors has commissioned Eugene McAlear, consulting engineer, Chicago, to prepare estimates for the construction and maintenance of a central light, heat and power plant for the group of county buildings at Wauwatosa, at an approximate cost of $75,000.

MORGANTOWN, W. VA.—West Virginia Power & Transmission Company has been incorporated with a capital stock of $50,000 for the purpose of generating electricity from water power. The incorporators are P. J. Crogan, Kingwood; Frederick W. Scheidenhelm, Gerard H. Matthews, Mellen C. Wiley and Harold A. Dunn, Connellsville, Pa.

GUADALAJARA, MEX.—It is announced by Eugenio Pinzon, manager of the Chapala Hydro-Electric and Irrigation Company, that it has been definitely decided to extend the company's system of power transmission lines to the Ameca mining district and the town of Ameca.

AUSTIN, TEX.—The City Water Power Company, with principal office in Hartford, Conn., has been granted a permit by the Secretary of State to do business in Texas. The company was recently organized for the purpose of taking over the contract with the city for the construction of a dam across the Colorado River here and the installation of a hydroelectric plant, the cost of the proposed improvements to be about $1,600,000. H. B. Freeman, Jr., of Hartford, is president; Charles F. Roberts, of New Haven, Conn., is secretary, and Frank S. Taylor, engineer, is the Austin representative of the company. Some preliminary work towards the construction of the dam is now being done, but contract has not yet been awarded. D.

SYRACUSE, N. Y.—The Syracuse Lighting Company is making plans to issue $220,000 worth of bonds for the extension of its distributing system and other improvements.

SPRINGFIELD, ILL.—The Illinois Northern Utilities Company has been incorporated with a nominal capital stock of $1,000, which will be increased as needed for the merger of the Rock River power and lighting plants.

MURRAY, KY.—A committee composed of H. S. Gilbert, T. Beale and L. M. Overby has in charge the matter of arranging for the purchase of equipment for the electric light plant at this place.

MONTGOMERY, ALA. — James Mitchell, president of the Alabama Interstate Power Company, of Montgomery, has announced that a power station will be built in the immediate future on the Coosa River, near Wetumpka, for supplying current to Birmingham.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

KIESTER, MINN.—The Kiester Telephone Company will construct a line to Alden. C.

WILLMAR, MINN.—It has been voted to grant a telephone franchise to A. C. Bowe, of St. Paul. C.

WENDELL, MINN.—A farmers telephone company has been organized and C. Johnson has been elected secretary. C.

CADILLAC, MICH.—The Michigan State Telephone Company is preparing to expend $50,000 on enlarging its aerial plant.

DEMING, N. M.—The Luna County Telephone Company will construct a long-distance line from Deming to Hondale, Iola and Columbus. D,

HOLLAND, MICH.—The Citizens Telephone Company has announced that about $7,000 will be expended for improvements this spring.

COOKEVILLE, TENN.—Dotson Branch Telephone Company has been incorporated by H. Brimsley, B. D. Welch, J. W. Owens and others.

SHELBY, MONT.—The Farmers Telephone Company has been incorporated with a capital of $10,000. It is stated that construction work will soon be started. C.

WALNUT GROVE, MINN.—The North Star Telephone Company has been organized with William Bondeson, president and W. D. Pierson, secretary. C.

BROWERVILLE, MINN.—The East Hartford Telephone Company has been organized. L. I. Baron, Jr., is president, and Theodore Johnson, secretary. C.

NORRISTOWN, PA.—It has been announced that the Bell Telephone Company will spend $6,500 on an additional toll circuit between Norristown and Centre Point.

TOLLSBURG, O.—Louisa & Webbville Telephone Company has been incorporated with a capital stock of $1,000 by R. Collinsworth, John Hall and W. V. Roberts.

BETHUME, S. C.—Bethume Telephone Company has been incorporated with a capital stock $1,000 by H. H. Holder, C. O. Terry, J. A. Stone and H. W. Northcutt.

ALBERT LEA, MINN.—The Tri-State Telephone Company will construct more toll lines to this city this summer, a line to Mankato and Winnebago and Blue Earth. C.

GILBERT, IOWA.—Hilbert Telephone Company has been incorporated with a capital stock of $10,000. The incorporators include H. Sawyer, A. Jones and F. Orning.

HOT SPRINGS, ARK.—Arkansas Telephone Company has been incorporated with a capital stock of $100,000 by John T. Gray, W. H. Connell and James L. Graham.

SALMON, TEX.—The Farmers' Union Telephone Company has been organized here. It will install a local exchange and construct long-distance lines to a number of places in this locality. D.

FOYIL, OKLA.—Blue Creek Rural Telephone Company has been incorporated with a capital stock of $375 by B. F. Matthews, W. C. Skelton and J. E. Lafferty, all of Foyil.

LUXEMBERG, WIS.—The Pilsen Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are John Jisa, Joseph Kulhanek and Thomas Stodola.

WILSON, WIS.—The Wilson Telephone Company has been incorporated with a capital stock of $4,000. The incorporators are Frank Freihammer, Peter Knemmet and C. Roehrborn.

MARLOW, OKLA.—The Marlow & Big Beaver Telephone Company has been incorporated with a capital stock of $1,008 by Harley Peters, C. D. Julian and P. C. Hockenburg, all of Marlow.

SANTA MONICA, CAL.—The Pacific Telephone Company will start work at once laying a cable from this city to Venice to carry wires. It is estimated that the work will cost $18,000.

AMARILLO, TEX.—The Panhandle Telephone & Telegraph Company has sold its holdings to the Southwestern Telephone & Telegraph Company, who, it is announced, will make many important improvements to the property. D.

RIDGELAND, S. C.—The Jasper Telephone Company has been incorporated with a capital stock of $5,000. C. E. Penny is president, D. O. Fleming, vice-president, and J. P. Wise, secretary-treasurer of the new company.

MARSHFIELD, MINN.—J. C. Marsh, owner of the Marshfield telephone system, will make improvements this summer to the amount of $15,000. This will include a new switchboard, 2,500 feet of cable and over 100 new poles. C.

FARGO, N. D.—River Line Telephone Company has been incorporated with a capital stock of $1,300 to build a line from Fargo to Wild Rice. The directors are W. W. Cook and Emil Headland, of Fargo, and Frank McKenzie, of Wild Rose.

BELLVIEW, IND.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $10,000. The directors are Dawson Smith, Charles King, Wiley Tague, David Stevenson, John Highly, Joseph Risk, Corry Brinson, Thomas Miller, Ray Bushman, Walter Day, William Koukle, Charles Geisten, David Gordon, Charles E. Taylor and Charles E. Cleek. The company is in the market for material and expert labor to build and equip a telephone plant in Bellview and extend the lines throughout Jefferson and Ripley Counties.

ELECTRIC RAILWAYS.

(Special Correspondence.)

RICHMOND, IND.—An up-to-date street car line is proposed to connect the Ginter Park line with Myrtle Grove Park.

RICHMOND, CAL.—A franchise has been granted to the Southern Pacific Company to build an electric line the full length of Cutting Boulevard.

NASHVILLE, TENN.—The Nashville Railway & Light Company is planning the construction of an extension to Belle Meade and Inglewood, suburbs of that city.

CHICAGO, ILL.—The Insull-Cobe interests have organized the Chicago & Interurban Railway, with C. M. Mattison as president, to take over the electric lines in Pullman and Whiting Districts.

NEW YORK, N. Y.—The Coney Island & Brooklyn Railroad Company has obtained permission from the Public Service Commission to expend $99,755 on replacements and betterments.

DALLAS, TEX.—The Southern Traction Company has been incorporated with a capital stock of $7,500,000. The incorporators are J. F. Strickland, C. W. Hobson and Osce Goodwin.

ALLIANCE, OHIO.—The Stark Electric Railroad Company has been making a preliminary survey for an Alliance-Akron line and there seems to be no question but that this interurban line will be built.

PASADENA, CAL.—It is reported that the issue of $2,000,000 worth of bonds of the Pasadena Rapid Transit Railroad Company has been sold to an English syndicate. The line will now be built to Los Angeles.

CHICAGO, ILL.—Rochelle, Oregon DeKalb Electric Railway Company has been incorporated with a capital stock of $2,500 to construct and operate an electric railway between Rochelle, Freeport and Oregon, Ill.

FLORENCE, S. C.—J. C. Williamson, J. W. McCown, J. L. and W. R. Barringer have organized a company with a capital stock of $25,000 for the purpose of building several miles of track and operating storage-battery cars.

WILLOWS, CAL.—The Executive Committee of the Sacramento Valley West Side Electric Railway has ordered a survey from Woodland *via* Dixon to a point on the Sacramento River, touching the line of the Oakland, Antioch & Eastern electric line, a distance of 33 miles.

GLASGOW, KY.—George R. Lewis is interested in the Kentucky Central Electric Company, which has been chartered with $1,000,000 capital stock in Delaware to build a traction line in Southern Kentucky. The incorporators are S. E. Robertson, M. L. Rogers and H. W. Davis, Wilmington.

BELLVILLE, TEX.—C. J. von Rosenberg, La Grange, has been elected president; C. M. Hellmuth, Beeville, vice-president; C. F. Knolle, Industry, secretary, and H. F. Schulze, treasurer of a company which has been organized with $100,000 subscribed, to build an interurban between LaGrange and this place.

CRAWFORDSVILLE, IND.—Joseph E. Elliott & Sons, security dealers of

Indianapolis, have purchased the Indianapolis, Crawfordsville & Western Traction line and it is rumored that a survey has been completed for a line 45 miles long to connect Crawfordsville with Danville, Ill., making it possible to travel from St. Louis to Cleveland by trolley. S.

ALBANY, N. Y.—The Sullivan County Railroad Company has been incorporated with a capital stock of $200,000 to build and operate a street surface electric road 14 miles long from Liberty, *via* White Sulphur Springs and Youngsville, to the village of Jeffersonville. The directors include Lowell H. Brown, Archer Brown and Stanley F. Crocker, all of New York City.

FORT WORTH, TEX.—The Texas Traction Company has been conducting an investigation of the territory between Sherman and Ardmore, Okla., with a view to constructing an extension of its interurban electric line to the latter place. The company is also considering the question of constructing a dam across the Washita River in Oklahoma and the installation of a hydroelectric plant to provide power for operating its lines. D.

EVANSVILLE, IND.—Charles Murdock, of Lafayette, has been elected president; Charles Finley Smith, vice-president, and J. W. Nowland, secretary, of the new company formed by the merger of the Evansville & Southern Indiana Traction Company and the Evansville Public Service Company. It is planned to abandon the old powerhouse of the traction company and greatly enlarge that of the Public Service Company and furnish power to the new traction company now building between Evansville and Henderson. S.

NEW INCORPORATIONS.

MUSKOGEE, OKLA.—The Electric Contracting Company has been incorporated with a capital stock of $2,500 by C. D. Dunbar, R. Dunbar and C. P. Gotwals, all of Muskogee.

CHICAGO, ILL.—R-W Electric Company has been incorporated with a capital stock of $5,000 to manufacture electrical supplies. The incorporators are M. M. Choate, H. L. Edwards and L. E. Murray.

BARTLESVILLE, OKLA.—Electrical Specialty Company has been incorporated with a capital stock of $50,000. The incorporators are H. V. Foster, R. D. Rood and James P. Anderson, all of Bartlesville.

NEW YORK, N. Y.—Typhoon Fan Company has been incorporated with a capital stock of $10,000 to manufacture electric fans, etc. The incorporators are Otto Person and Ernest Glantzberg, of New York City.

NEW YORK, N. Y.—Interstate Electric Novelty Company has been incorporated with a capital stock of $130,000. The incorporators are Alfred Wolff, Samuel I. Posen, New York City, and Joseph Block, Brooklyn.

ONEIDA, N. Y.—In our issue of April 6 the incorporators of the Sylvan Beach Electric Light & Power Company should have read Ira L. Snell, Roswell B. Downing, Anthony T. Garvin, M. Cavana and Mrs. Anna Heimstreet.

LONG LAKE, N. Y.—Long Lake Light, Heat & Power Company has been incorporated with a capital stock of $8,000. The inccorporators are Henry D. Kellogg, John P. Brannen and Lewis L. Jennings, all of Long Lake, N. Y.

CHICAGO, ILL.—Union Electric Engineering Company has been incorporated with a capital stock of $2,500 to manufacture electric motors and machinery. The incorporators are Ambrose A. Wersley, Walter P. Stuart and Hugo Krause.

NEW YORK, N. Y.—Indelectric Manufacturing Company has been incorporated to manufacture electrical goods with a capital stock of $100,000. The incorporators are Charles H. Melsome and Joseph A. Smith, of New York City, and Melville R. Dunton, of Newark, N. J.

PROPOSALS.

ELECTRIC ELEVATORS.—Sealed Proposals indorsed "Proposals for Passenger Elevators" will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 11 for installing three electric passenger elevators; one in the naval hospital at Chelsea, Mass.; one in the naval hospital, Newport, R. I.; and one in the naval hospital, Portsmouth, N. H. Plans and specifications may be obtained on application to the Bureau.

ELECTRICAL SUPPLIES.—Proposals will be received until May 7 by the Navy Department, Bureau of Supplies and Accounts, Washington, D. C., for the following material:

Article.	Quantity.	Delivered at navy yard.	Schedule
Cable, single conductor, paper insulated, lead sheathed	6,555 feet	Brooklyn, N. Y.	4473
Winch, electric driven	1	Norfolk, Va.	4474
Graphite, lubricating	2,000 pounds	" "	4483
Starters, automatic, motor, electric	16	Philadelphia, Pa.	4484

Schedules may be obtained from the Navy Pay Office nearest each Navy Yard. In making application the schedule number should be given.

ELECTRIC PASSENGER ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 17 for an electric passenger elevator in the post office and court house at Great Falls, Mont., in accordance with drawings and specifications, copies of which may be obtained at the office of the Supervising Architect.

ELECTRIC PASSENGER ELEVATOR.—Sealed proposals will be received by the Treasury Department, Office of the Supervising Architect, Washington, D. C., until May 13 for two electric passenger elevators to be used in the reconstruction of the post office at Richmond, Va.; until May 17 for one electric passenger elevator to be used in the post office at Great Falls, Mont.; until May 18 for one electric passenger elevator to be used in the post office at Oklahoma City, Okla. Copies of drawings and specifications may be obtained from the office of the Supervising Architect.

ELECTRIC CONDUITS AND WIRING, AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 2 for electric conduits and wiring, and interior lighting fixtures of a one-story building for the post office at Crowley, La.; until May 4 of a one-story building for the post office at Hillsboro, Tex.; until May 7 of a two-story building for the post office at Olympia, Wash. Specifications may be obtained from the office of the Supervising Architect or from the custodian of the various sites.

ELECTRIC CONDUITS AND WIRING, AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 21, for electric conduits and wiring, and interior lighting fixtures of a one-story building for the post office at Alameda, Cal.; until May 24 of a one-story building for the post office at Bonham, Tex.; until May 25 of a one-story building for the post office at West Point, Miss.; until May 27 of a one-story building for the post office at Westfield, Mass. Drawings and specifications may be obtained from the custodian of the various sites or from the office of the Supervising Architect.

NEW PUBLICATIONS.

FACTORS IN FOREIGN TRADE.—The Bureau of Manufactures, Washington, D. C., now has in press a bulletin that will no doubt find a permanent place on the desk of every manufacturer interested in foreign trade. In its 56 pages will be found answers to questions asked by every manufacturer sending out trade literature or opening correspondence with foreign firms regarding what language is best to use, in what currency, weights and measures prices should be quoted, what postage should be placed on the catalog or letter, prepayment of replies, parcels post, etc. Supplementing these statements are tables for converting the money of foreign countries into that of the United States; also a comparison of prices for 30 countries in which both the monetary unit and the units of weight and measure differ from those used in the United States.

KEOKUK HYDROELECTRIC DEVELOPMENT.—The Mississippi River Power Company has issued Bulletin No. 5 showing the development of the hydroelectric project at Keokuk up to March. The power-house construction is well advanced and a drawing is given showing the details of one of the main turbine units of 10,000 horsepower, which is direct-connected to a generator. The turbine has a vertical shaft 25 inches in diameter and is of the reaction type. The weight of the rotating part including the generator will be approximately 550,000 pounds. Fifteen of these units will be erected in the first installation and room will be provided for 15 additional. The concrete work has been carried on during the winter by the use of salamanders and steam pipes in juxtaposition to the work, which is kept covered with canvas. The dam now lacks 450 feet of closing the river. It is expected to have the lock, which is to be turned over to the United States Government, ready for use by the time spring navigation opens. The lift of this lock is 40 feet.

FINANCIAL NOTES.

The Governing Committee of the New York Stock Exchange has admitted to listing $19,997,700 of the common stock of the New York State Railways.

The $5,000,000 Montreal Tramways & Power Company six-per-cent notes, offered by New York City bankers, have been oversubscribed.

The Chicago Elevated Railways Company has applied to the New York Curb Association to obtain listing privileges for its five-per-cent notes.

The issue of Atlantic City Electric Company five-per-cent first and refunding bonds, purchased by E. B. Smith & Company, has all been sold.

Directors of the West End Street Railway Company opened proposals recently for the purchase of $754,000 twenty-year 4.5-per-cent bonds, proceeds to pay in part necessary cost of permanent additions and improvements to property made by Boston Elevated in accordance with terms of lease. There were ten bids received, award being made to E. H. Rollins & Sons and Perry, Coffin & Burr, of Boston, jointly.

Spencer Trask & Company, New York City, is offering Beloit Water, Gas & Electric Company first-mortgage five-per-cent sinking-fund gold bonds at a price to yield about 5.3 per cent on the investment. The bonds are part of an outstanding issue of $300,000 authorized, together with $500,000 seven-per-cent cumulative preferred stock by the Wisconsin Railroad Commission. Reproduction value of the property is placed at $1,304,628. Earnings of the company have showed a steady increase for the past five years, and net income for the calendar year 1911 was more than twice the interest requirements on the first-mortgage five-per-cent bonds now outstanding.

The Chicago Telephone Company has sold $15,000,000 five-per-cent bonds for extensions and improvements to a syndicate composed of Harris Trust, Illinois Trust, First Trust, Northern Trust, Merchants Loan Trust, and Lee, Higginson Company. Early offerings will probably be made to the public at 102½ to 103, or about the present market quotation. The Company's authorized bond limit is $50,000,000. Five million dollars of the same bonds were sold in 1908, so the present issue will make $20,000,000 outstanding and will carry the Company's financial needs many months ahead. The Company's new office building cost $2,000,000 and floating debt aggregates nearly $2,000,000, as the company borrowed from banks extensively during the past two years.

Dividends.

Binghamton Light, Heat & Power Company; a quarterly common dividend of 0.75 per cent, and a preferred dividend of 1.5 per cent, both payable April 15 to stock of record March 30.

Columbus Railway Company; a quarterly preferred dividend of 1.25 per cent, payable May 1 to stock of record April 15.

Edison Electric Illuminating Company of Boston; a quarterly dividend of three per cent, payable May 1 to stock of record April 15.

Electric Bond & Share Company; a quarterly common dividend of two per cent, payable April 15 to stock of record April 13; and a quarterly preferred dividend of 1.5 per cent, payable May 1 to stock of record April 18.

Havana Electric Company; quarterly common and preferred dividends of $1.50 per share on both the common and preferred stocks, payable May 18 to stock of record May 1.

Houghton County Electric Light Company; a semi-annual common dividend of 2.5 per cent, and a preferred dividend of six per cent, both payable May 1 to stock of record April 16.

Lewiston, Augusta & Waterville Street Railway Company; a quarterly preferred dividend of 1.5 per cent, payable May 1 to stock of record April 15.

Milwaukee Electric Railway & Light Company; a quarterly preferred dividend of 1.5 per cent, payable April 30 to stock of record April 20.

Minnesota General Electric Company; a quarterly dividend of $2 per share, payable May 1 to stock of record April 17.

Northumberland Gas & Electric Company; a semi-annual preferred dividend of 2.5 per cent, payable April 15 to stock of record April 1.

Public Service Investment Company; a quarterly preferred dividend of $1.50 per share, payable May 1 to stock of record April 16.

Railway Company General; a regular quarterly dividend of one per cent, payable May 1 to stock of record April 20.

Sayre Electric Company; a quarterly common dividend of one per cent, and a preferred dividend of 1.5 per cent, both payable April 15 to stock of record March 30.

Cape Breton Electric Company; a semi-annual common dividend of $2 a share, and a semi-annual preferred dividend of $3 a share, both payable May 1 to stock of record April 17.

Reports of Earnings.

NIAGARA, LOCKPORT & ONTARIO POWER.

The Niagara, Lockport & Ontario Power Company reports for the year ended December 31, 1911: Gross earnings, $564,343; net earnings, $401,231; total income, $424,210; deficit after charges, sinking fund, etc., $18,421; total assets as of December 31, 1911, $11,638,584; cash, $106,731; current and working assets, $253,230; current liabilities, $257,707; reserves, $420,592; profit and loss surplus, $89,880.

UNITED TRACTION COMPANY.

The report of the United Traction Company (Albany) for the quarter ended December 31, 1911, compares as follows:

	1911.	1910.
Gross	$584,415	$599,807
Net after taxes	137,699	181,177
Other income	63,494	56,335
Total income	201,193	237,512
Surplus after charges	96,315	131,341

PHILADELPHIA ELECTRIC COMPANY.

The annual report of the Philadelphia Electric Company for the year ended December 31, 1911, compares as follows:

	1911.	1910.
Gross	$6,425,590	$5,946,026
Operating expenses and fixed charges	5,021,849	4,729,647
Net increase	1,403,341	1,216,378
Dividends	899,724	877,237
Surplus	504,007	339,141
Previous surplus	623,375	1,783,499
Total surplus	1,127,393	623,375

Directors of the Philadelphia Electric Company were re-elected.

NEW ORLEANS RAILWAY.

The report of the New Orleans Railway & Light Company for the year ended December 31, 1911, shows net earnings of $2,915,813, against $2,723,485 in 1910. The consolidated income account compares as follows:

	1911.	1910.
Total operating revenue	$6,652,937	$6,245,223
Total operating expenses	3,737,124	3,251,738
Net operating revenue	$2,915,813	$2,723,485
taxes	11,882,733	11,196,759
Operating income	$2,375,283	$2,220,530
Other income	44,157	24,312
Total income	$2,419,440	$2,244,843
Interest, reserve, etc	1,647,744	1,601,554
Surplus	$ 771,696	$ 643,289
Preferred dividend	499,750	249,875
Surplus	$ 271,946	$ 393,414

MICHIGAN STATE TELEPHONE.

The Michigan State Telephone Company has issued its pamphlet report for the year ended December 31, 1911. The income account compares as follows:

	1912.	1911.
Gross revenue	$4,605,069	$4,225,174
Expenses and taxes	3,638,043	3,280,420
Net	967,026	944,754
Other income	36,943	27,908
Total income	1,003,969	972,662
Special expenses, inc. bd. disc.	.....	.....
Net	1,003,969	972,662
Interest	516,026	464,928
Surplus	*487,943	507,734
Divdends	258,039	258,039
Surplus	229,904	249,695
Previous surplus†	694,451	573,558
Total surplus	924,355	823,253
Deductions	38,247	7,754
Profit and loss surplus	886,108	815,499

*Surplus after payment of six per cent dividends on preferred stock is equal to 5.85 per cent earned on $6,000,000 common stock, compared with 6.18 per cent earned on same stock in previous year.

†After deducting dividends for prior year, paid in current year.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	April 15.	April 8.
Allis-Chalmers common (New York)	1½	2
Allis-Chalmers preferred (New York)	4½	5¾
American Tel. & Tel. (New York)	145¼	145⅝
Chicago Telephone certificates (Chicago)	*144	*144
Commonwealth Edison (Chicago)	146½	146
Edison Electric Illuminating (Boston)	285	292
Electric Company of America (Philadelphia)	12⅛	12
Electric Storage Battery common (Philadelphia)	54¾	55½
Electric Storage Battery preferred (Philadelphia)	54¾	55½
General Electric (New York)	169¾	169½
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	2	2
Massachusetts Electric common (Boston)	20½	21¼
Massachusetts Electric preferred (Boston)	95	94½
National Carbon common (Chicago)	103	102½
National Carbon preferred (Chicago)	115	118
New England Telephone (Boston)	159½	158½
Philadelphia Electric (Philadelphia)	18⅝	18½
Postal Telegraph and Cables common (New York)	86½	81¼
Postal Telegraph and Cables preferred (New York)	69¼	69
Western Union (New York)	82⅝	83
Westinghouse common (New York)	75	75½
Westinghouse preferred (New York)	*115	115

*Last price quoted.

PERSONAL MENTION.

OSCAR B. COBLENTZ has been appointed general manager of The Morris Iron Company, Frederick, Md.

H. A. KINNEY, Woodbine, has been made president of the Independent Telephone Operators of Iowa.

A. P. MUNNING, president of the Munning-Loeb Company, Matawan, N. J., was among the recent electrical visitors to Chicago.

GERARD SWOPE, sales manager of the Western Electric Company, will sail this month for a three months' trip to England and the Continent.

D. OWENS, who has been local manager of the Cumberland Telephone Company, Hickman, Ky., for the past five years, has resigned to take a traveling position.

DANA HOWARD, advertising manager, Commonwealth Edison Company, has been elected secretary of the recently formed Chicago Section of the Electric Vehicle Association of America.

W. M. SKIFF, assistant manager of the Engineering Department, National Electric Lamp Association, read a paper on "The Management of Laboratory Work and the Elimination of the Personal Equation" before the New York Section of the Illuminating Engineering Society, on April 11.

C. G. YOUNG has changed his offices from 60 Wall Street, New York City, to a suite on the twenty-eighth floor of the Bankers' Trust Building, the new structure at the corner of Wall and Nassau Streets. These new and commodious quarters will furnish the much needed facilities for extending Mr. Young's work in the line of engineering construction and financing of public utilities.

ALPHA H. KLING, general manager of the Detroit Fuse & Manufacturing Company, Detroit, Mich., who has been abroad for the last two months, is visiting Rome, Italy, where he and Mrs. Kling are enjoying a delightful rest. Mr. Kling writes that they will stop at Rome for several weeks. They are both enjoying very good health, and expect to remain abroad for some time.

ELMER P. MORRIS, vice-president and sales manager of the Morris Iron Company, will in the future make New York his headquarters. During the past year he has been located at Frederick, Md., where has has had charge of the construction of the new plant. Mr. Morris will devote his personal attention to the sales department, which will be located at 90 West Street, New York City.

A. T. MACDONALD, general sales manager of the Louisville Lighting Company, will leave April 30 to attend the annual convention of the Mystic Shriners in Los Angeles, Cal., taking advantage of the trip to study Coast conditions prior to attending the convention of the National Electric Light Association in Seattle, June 14. He will visit San Francisco and other California and Washington communities, and expects to look particularly into the sales methods which have been employed there.

L. E. BEILSTEIN, vice-president and general manager of the Toledo Railways & Light Company, has tendered his resignation, to take effect April 30. He will retain his position on the board of directors. He has been with the Toledo Railways & Light Company for the past eleven years, coming from the Northern Ohio Traction Company, prior to which time he was connected with the Detroit Electric Railway. Mr. Beilstein has announced that he will remain in Toledo. His successor has not been selected.

H. H. MAGDSICK, at a meeting of the Pittsburg Section of the Illuminating Engineering Society, on Friday evening, April 12, spoke on the subject, "Gas, Gasoline, Arc and Incandescent Street Lighting." In Mr. Magdsick's paper comparisons were made between ornamental street lighting employing Mazda lamps and other forms of street illumination as regards light distribution, operating features and maintenance cost. The paper was of unusual interest because it involved both theory and practice of a subject which is much under discussion today.

OBITUARY.

GILBERT B. SHAW died on April 13 at his late residence in Chicago, and was buried at Moline, Ill., his early home. Mr. Shaw had large interests and was connected with the Guarantee Electric Company and the Naugle Pole and Tie Company.

With the Electrical Manufacturers

The Habirshaw Wire Company has removed its New York City offices to more commodious quarters on the twenty-seventh floor of the Metropolitan Tower.

The H. T. Paiste Company, Philadelphia, Pa., has issued bulletin 83, which is a catalog of Paiste Multipo sockets of various types equipped with Edison base. Similar rosette sockets are also mentioned and a new form of corner molding Taplet.

The Sangamo Electric Company, Springfield, Ill., has issued a new booklet devoted to a description of the ampere-hour meter as applied to pleasure and commercial vehicles. It will be of particular interest to central-station managers who are now encouraging the electric-vehicle business.

The Simplex Electrical Company and the **Simplex Electric Heating Company** have removed their Chicago offices and warehouse to 15-21 South Desplaines Street, where more commodious quarters enable these companies to carry a larger stock of their well known wires and cables, and electric heating appliances.

The Rochester Electric Motor Company, Rochester, N. Y., has removed its office and salesrooms to its new plant at 266 Lyell Avenue. This factory was opened last November. By centralizing the entire organization under one roof the company is in better position to give prompt and effective service to its patrons.

The Crocker Wheeler Company, Ampere, N. J., has issued an attractive bulletin describing its electric fans. The details of construction are fully explained and illustrated. The various types of fans made by the company are described and their advantages carefully pointed out. Typical illustrations show the adaptation of the fan for various office and household purposes.

The Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, has published catalog No. 26. This is a 57-page pamphlet devoted to Union inclosed fuses and fuse blocks for all kinds of service, combination switches and cutouts, block fittings, telegraph, telephone and fire-alarm fuses and fuse blocks, open fuse links, sheet-metal fuses and standardized fuse wire.

The Westinghouse Electric & Manufacturing Company has issued descriptive leaflet 2440, which describes the Westinghouse split-frame commutating-pole railway motor type 232-A. This motor has a rating of 32 horsepower at 500 volts and 38 horsepower at 600 volts. The leaflet describes and illustrates in detail the component parts of the motor and shows the performance curves at both the rated voltages.

National Electric Lamp Association, Cleveland, O., which is sustained by certain works of the General Electric Company, has issued through its Engineering Department Bulletin 10 B, entitled "Train-Lighting Lamps." This bulletin covers the description, performance and economy of Mazda and Gem lamps in train-lighting service, and copies may be secured upon application to the Engineering Department.

The Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago, has issued bulletin No. 10, devoted to industrial lighting fixtures. It describes reflector sockets of various types, industrial clusters, wireless fixtures, inclosed street clusters and large single-unit incandescent fixtures of the pendent, ceiling and bracket types. Other lighting specialties, such as reducers, lamp grips and fittings, are also described.

The Allen-Bradley Company, 495 Clinton Street, Milwaukee, Wis., has purchased the rheostat department of

the American Electric Fuse Company, which recently went into bankruptcy at Muskegon, Mich. This purchase includes all the drawings, patterns, tools, dies, engineering data, patents, etc., and enables the Allen-Bradley Company to more adequately meet the demands of its many patrons for compression electric controlling devices.

Buffalo Foundry & Machine Company, Buffalo, N. Y., had its plant damaged to the extent of about $10,000 by fire on the morning of April 11. The building was of fireproof construction, consisting mainly of steel and glass, the latter making the work of the firemen hazardous. The principal damage was done to the roof, to which the blaze spread from the core room, where it started. The building is 145 by 320 feet in size and contains 175,000 square feet of ribbed glass. Interference with the work of the plant was not serious and it was running as usual this week.

The Rockwood Manufacturing Company, Indianapolis, Ind., is sending out, to those interested in pulleys for belt drives, copies of a paper by Prof. W. M. Sawdon of Cornell University, entitled "Tests of the Transmitting Capacities of Different Pulleys in Leather Belt Drives." This paper was presented before the convention of the National Association of Cotton Manufacturers last fall. It gives the results of exhaustive tests and shows that the highest transmitting capacity and lowest belt slip are obtained with plain paper pulleys, such as the Rockwood Manufacturing Company produces.

Copper Hewitt Electric Company, Hoboken, N. J., has issued a pamphlet dealing with "Principles of Industrial Lighting" and designated as Bulletin No. 43. This is a compilation by George C. Keech, of the Chicago office, of extracts from the Baltimore series of lectures given by the Illuminating Engineering Society and the Johns Hopkins University in co-operation. Numerous quotations are given from the lectures by Messrs. Hyde, Marks, Yerkes, Steinmetz and Cobb bearing upon the suitability of the light from the mercury-vapor lamp for purposes of illumination. There is also an extract from a paper by Messrs. Bell and Williams dealing with the advantages of monochromatic light in increasing visual acuity. Conclusions are drawn from these statements indicating the advantages of the Cooper Hewitt lamp for various purposes. This bulletin will be sent to those interested upon request.

DATES AHEAD.

Iowa Electrical Association. Annual meeting, Des Moines, April 24-25.

Iowa Street and Interurban Railway Association. Annual meeting, Des Moines, April 25-26.

Association of Iron and Steel Electrical Engineers—American Institute of Electrical Engineers. Joint meeting, Pittsburgh, Pa., April 25-27.

Southwestern Electrical and Gas Association, San Antonio, Tex., April 25-27.

American Institute of Electrical Engineers. Schenectady, N. Y., May 17.

Arkansas Association of Public Utility Operators. Annual convention, Little Rock, Ark., May 20-22.

Mississippi Electric Association. Fourth annual convention, Vicksburg, Miss., May 28-30.

National Electric Light Association. Annual convention, Seattle, Wash., June 10-14.

Minnesota Electrical Contractors' Association. Annual convention, Duluth, Minn., June 16.

Michigan Section of the National Electric Light Association. Annual convention on board the *Majestic* sailing from Port Huron, Mich., on June 21.

Society for the Promotion of Engineering Education. Annual meeting, Boston, Mass., June 25-27.

American Institute of Electrical Engineers. Annual convention, Boston, Mass., June 25-28.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 16-19.

Ohio Electric Light Association. Annual convention, The Breakers, Cedar Point, O., July 17-19.

The 1912 Boston Electric Show, Mechanics' Building, Boston, Mass., September 28-October 26.

American Electric Railway Association. Annual convention, Chicago, Ill., October 7-11.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Manhattan, Kans., October 17-19.

Record of Electrical Patents.

Issued by the United States Patent Office, April 9, 1912.

1,022,423. Branch Block for Electric Moldings or Conduits. G. A. Jordan, New York, N. Y. Has a bridge over the mains to carry the branch wires.

1,022,426. Arc-Light Electrode or Pencil. I. Ladoff, Cleveland, O., assignor of three-tenths to P. C. Peck, New York, N. Y. An iron tube contains an intimate mixture of powdered iron and titanium oxide.

1,022,433. Garment for Stage Effects. A. L. McMurtry, Sound Beach, Conn. Differently colored incandescent lamps are inserted in the dancer's skirt and controlled by a switch at the belt.

1,022,446. Sprinkler-Alarm Device. E. L. Thompson, and J. R. Hamilton, assignors to Venturi Alarm Co., Dover, N. J. Reduction in pressure causes an electric alarm to ring.

1,022,482. Filament Connection. J. W. Howell, assignor to General Electric Co. A connection between a tungsten filament and its conductor consists of sintered metallic powder partially fused.

1,022,487. Electroplating Apparatus. G. A. Lutz, assignor to American Circular Loom Co., Portland, Me. Relates to means for supporting the anodes and cathodes.

1,022,497. Alarm Apparatus. J. D. Nelson and E. F. Smith, Cincinnati, O., said Smith assignor to said Nelson. A manometer affected by the pressure in a tank governs an electric alarm and signal indicator.

1,022,498. Control Apparatus. E. F. Northrup, assignor to Leeds & Northrup Co., Philadelphia, Pa. Control for a recording system associated with a galvanometer.

1,022,503. Bearing for Electric Meters. W. H. Pratt, assignor to General Electric Co. A ball bearing supported on a spring plug in a socket.

1,022,514. Arc-Lamp Hanger. G. E. Stevens, assignor to General Electric Co. A locking device adapted to engage and disengage a plug.

1,022,517. Electrical Measuring Instrument. E. Thomson, assignor to General Electric Co. The current coil moves between the annular eccentric poles of a permanent magnet.

1,022,519. Telephone Repeater. N. G. Warth, Columbus, O. The relay has a long slender core adapted to be expanded longitudinally by telephone currents and thus actuate a repeating microphone.

1,022,522. Telephone-Exchange System. H. G. Webster, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Includes a repeating coil with line, cut-off and supervisory relays.

1,022,523. Concentration of Solids in Liquids. W. R. Whitney, assignor to General Electric Co. The process of preserving milk solids consists in electrically migrating a disinfectant through the milk, thus destroying bacteria.

1,022,526. Method of and Apparatus for Recording Marine Conditions. H. T. Barnes, Montreal, Quebec, Can. The proximity of icebergs is determined from readings of the sea-water temperature taken by an electrical thermometer.

1,022,527. Arc-Lamp Hanger. J. T. Beechlyn, assignor to General Electric Co. A pawl holds the movable part in place until the latter is raised the second time.

1,022,532. Time-Controlled Electric Switch. C. M. Crook, assignor, to E. E. Yaxley, Chicago, Ill. An electric time stamp has its figures periodically advanced through a clock-controlled circuit.

1,022,536. Snap Switch. F. C. De Reamer, assignor to General Electric Co. Has rabbeted insulating washers engaging the switch blade.

1,022,539. Receiver for Electromagnetic Waves. R. A. Fessenden, assignor to National Electrical Signaling Co., Pittsburgh, Pa. A polarization cell is arranged as a wireless detector.

1,022,540. Wireless Signaling. R. A. Fessenden, assignor to National Electric Signaling Co. The receiving circuit is so balanced as to permit simultaneous sending and receiving with the same antenna.

1,022,541. Arc Lamp. R. Fleming and E. J. Guay, assignors to General Electric Co. A magnetite arc is started by bringing the electrodes together longitudinally and laterally.

1,022,543. Holder for Lamp Filaments. L. Glaser, assignor to General Electric Co. Consists of a mixture of refractory oxides with a pure thorium-oxide surface.

1,022,545. Electric Oven. J. G. Gronberg, and W. D. Hodson, assignors to Caloric Co., Janesville, Wis. The circuit of the heating coil is opened

when a certain temperature is reached.

1,022,546. Trolley Frog. Frank Guillot, assignor to General Electric Co. Removable tongues are clamped into hollow ribs at each end.

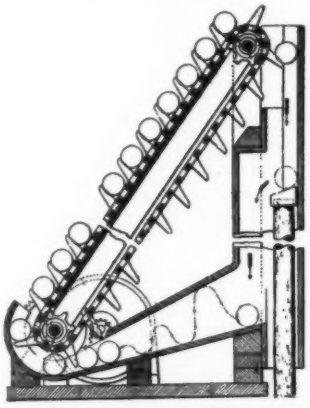
1,022,553. Method of Fusing Lamp Filaments to Leading-in Wires. J. W. Howell, assignor to General Electric Co. The copper wire is arranged to support the tungsten filament and then the ends are fused.

1,022,554. Welding Filaments to Metal Wires. J. W. Howell, assignor to General Electric Co. The welded joint for a tungsten filament contains copper and iron.

1,022,561. Eelctroplating Apparatus. G. A. Lutz, assignor to American Cirular Loom Co., Portland, Me. A modification of No. 1,022,487.

1,022,584. Method of Determining Frequency of Periodic Impulses. R. A. Fessenden, assignor to National Electric Signaling Co., Pittsburgh, Pa. An auxiliary circuit of known variable constants is brought into resonance with the circuit tested.

1,022,586. Electric Pile-Driver. C. D. Haskins, deceased, by F. J. Haskins, executrix, assignor to General Electric Co. Loose weights are raised by an electric conveyor and successively dropped on the head of the pile.



1,022,586.—Electric Pile-Driver.

1,022,589. Automobile Headlight. E. J. Lutwyche, Chicago, Ill. An incandescent lamp socket in the center of the reflector.

1,022,593. Device for Measuring Time Intervals. W. H. Pratt, assignor to General Electric Co. An electrical recording instrument enables an accurate comparison of the unknown with a substantially equivalent known interval.

1,022,605. Train-Staff System. V. K. Spicer and V. I. Smart, Montreal, Quebec, Can. Has an electromagnetic lock on the drawer.

1,022,619. Horn-Gap Switch and Lighting Arrester. A. W. Burke, Pittsburgh, Pa. The horns are normally out of contact, but brought in contact before the switch is opened so as to break the arc after the switch is opened.

1,022,628. Mechanism for Actuating Electrical Switches. B. D. Horton, assignor to Detroit Fuse & Manufacturing Co., Detroit, Mich. A starting and running switch for three-phase motors is actuated in definite sequence by the arms of a rock shaft.

1,022,629. Electrical Switch. A. H. Kling and B. D. Horton, assignors to Detroit Fuse & Manufacturing Co. The running switch has a fuse. The auxiliary starting switch has a heavy conductor shunted around the fuse.

1,022,634. Electric Searchlight for Automobiles. C. A. Lewis, Denver, Colo. Has a pair of horizontal carbons and a solenoid for striking the arc.

1,022,642. Low-Tension Sparking Mechanism for Gas Engines. H. J. Podlesák, Chicago, Ill. Relates to details of construction of a make-and-break system.

1,022,644. Remote-Control Apparatus. M. Scott, Philadelphia, Pa. A circuit-breaker has a remote-controlled motor for closing it.

1,022,666. Electrically Operated Driving Gear. J. A. Essberger, Berlin-Schöneberg, Germany. A number of motors drive a shaft through gear sets adapted to their speeds, a magnetic clutch intervening between the sets.

1,022,676. Marine Compass. H. Hertzberg, assignor to A. A. Low, Horseshoe, N. Y., M. J. Wohl, New York, N. Y., and H. Hertzberg, Brooklyn, N. Y. Includes a non-spillable cup with a float bearing for the magnet staff and a circuit-controller carried by the staff.

1,022,679. Pliers for Stripping Insulation from Electric Wires. F. P. Huston, Dumont, N. J. Each jaw carries a transverse splitting blade and a cutting blade at each end of the splitting blade.

1,022,797.—Shock-Absorbing Rosette.

1,022,695. Electrolytic Rectifier. W. Morrison, Des Moines, Ia. Consists of a cathode, a bismuth anode and an electrolyte of an alkali-metal chromate forming an asymmetric film on bismuth.

1,022,707. Solenoid Controller. F. W. Smith, assignor to Sundh Electric Co., New York, N. Y. A solenoid automatically controls the motor circuit and its resistance.

1,022,708. Time Switch for Electric Circuits. F. W. Smith, assignor to Sundh Electric Co. A spring motor closes the switch.

1,022,712. Method of Uniting Metal. E. Thomson, assignor to Thomson Electric Welding Co., Lynn, Mass. A rim is welded to a wheel by applying a tapered ring to the latter, passing current between the ring and rim and applying pressure.

1,022,713. Telephone System. F. C. Unger, St. Louis, Mo. A local-battery system with a central ringing machine and a machine for operating the line drops and clearing-out drop.

1,022,717. Lightning Arrester. A. J. Wurts, assignor to Union Switch & Signal Co., Swissvale, Pa. Has two fusible electrodes arranged with a spark gap between their ends and a capillary tube inclosing the electrodes.

1,022,739. Lock Guard for Incandescent Lamps. H. Hubbell, Bridgeport, Conn. A wire lamp guard is held by a locking plate whose two parts are secured by a key-controlled nut.

1,022,740. Guard for Incandescent Lamps. H. Hubbell, Bridgeport, Conn. Has a double attaching ring formed of a bent wire with a clamping screw joining eyes in its ends.

1,022,742. Indicator-Actuating Mechanism. O. E. Kellum, assignor to National Street & Station Indicator Co., Los Angeles, Cal. Is operated by a pawl on the oscillating armature of an electromagnet.

1,022,784 and 1,022,785. Marine Compass. H. Hertzberg, assignor to A. A. Low, Horseshoe, N. Y., M. J. Wohl, New York., and H. Hertzberg, Brooklyn, N. Y. Modifications of No. 1,022,676.

1,022,794. Support for Articles to be Electroplated. G. A. Lutz, assignor to American Circular Loom Co., Portland, Me. Has a tapering thread at its lower end to wedge the support against the inner walls of the article.

1,022,795. Electrical Measuring Instrument. C. McClair, assignor to General Electric Co. Relates to the construction of the magnet pole pieces.

1.022,919.—Shade-Holder.

1,022,797. Shock-Absorbing Rosette. S. B. Paine, assignor to General Electric Co. Comprises a flanged tubular plug having a countersink in its upper end, and a vibration-absorbing cushion of felt between the plug and the body of the rosette.

1,022,809. Electric Switch. L. B. Abbott, assignor to Harvey Hubbell, Inc. Bridgeport, Conn. A socket switch operated by a pull chain.

1,022,815. Separable Attachment Plug. R. B. Benjamin, assignor to Benjamin Electric Manufacturing Co., Chicago, Ill. The cap can be inserted into the plug by a straight push.

1,022,828. Dual Ignition System. R. H. Cunningham, New York, N. Y. Includes a battery and a magneto.

1,022,832. Magneto for Internal-Combustion Engines. A. Durbin, McConnelsville, O. Has the magnets eccentrically mounted on the face of a flywheel.

1,022,834. Electrical Fuse. Samuel F. Estell, Florence, Cal. A rechargeable cartridge fuse.

1,022,848. Electric Protective Circuit. O. Jacobson, assignor to Herring-Hall-Marvin Safe Co., Hamilton, O. The lock and door of a safe are included in an alarm circuit.

1,022,853. Support for Articles to be Electroplated. G. A. Lutz, assignor to American Circular Loom Co. A modification of No. 1,022,794.

1,002,874. Machine for Drilling Porcelain. J. Riddell, assignor to General Electric Co. Drills a semicircular hole in insulators.

1,022,875. Lighting Fixture. J. T. Robb, assignor to iMtchell-Vance Co., New York, N. Y. Has a set of movable jaws for grasping the opening of a spherical ceiling globe containing a high-efficiency lamp.

1,022,878. Diffusing Cluster. W. D'A. Ryan, assignor to General Electric Co. Has a reflector above the tungsten lamps, which are vertically adjustable, and a diffusing globe beneath and around them.

1,022,880. Current Transformer. L. M. Schmidt, assignor to General Electric Co. The primary winding consists of a stout bar divided longitudinally into insulated sections.

1,022,884. Insulated Rail Joint. W. H. Sellew, Detroit, and E. A. Everett, Highland Park, Mich. The splice bars and rail ends are insulated from each other.

1,022,895. Shade-Holder. W. S. Stapley, assignor to Bridgeport Brass Co., Bridgeport, Conn. The locking clamp is made of wire.

1,022,897. Resistance Unit. G. E. Stevens, assignor to General Electric Co. Comprises a flat resistance conductor doubled edgewise on itself and shaped to form two spirals with a spacing strip between them.

1,022,898. Motor for Advertisement-Display Apparatus. W. H. Thompson, Memphis, Tenn. An electromagnet rewinds the spring periodically.

1,022,904. Centrifugal Switch. C. J. Webster, assignor to General Electric Co. For use with single-phase motor.

1,022,906. Electric-Lamp Socket. H. Wheeler, assignor to General Electric Co. Is made of translucent material.

1,022,907. Control of Electrically Operated Switches. H. E. White, assignor to General Electric Co. Includes a number of contactors, and a pair of normally open relays arranged to temporarily close alternately to successively actuate the contactors.

1,022,908. System of Motor Control. M. A. Whiting, assignor to General Electric Co. Comprises electromagnetic switches for two induction motors, one of higher speed than the other, also a reversing switch and a limit switch.

1,022,910. Manufacture of Quartz Apparatus. W. R. Whitney, assignor to General Electric Co. Consists in electrically fusing the quartz and shaping it while in a vacuum.

1,022,912. Transformer Terminal. E. G. Winston, assignor to general Electric Co. A high-tension condenser-type terminal.

1,022,914. Electric Valve-Operating Device. H. Wurmb and R. Baumann, assignors to National Clock & Electric Manufacturing Co., St. Louis, Mo. A plunger reciprocating between two solenoids throws the valve handle to and fro.

1,022,917. Motor-Control System. T. von Zweigbergk, assignor to General Electric Co. A series-parallel car-control system.

1,022,919. Electric-Lighting Device. L. W. Andersen assignor to Plume & Atwood Manufacturing Co., Waterbury, Conn. A shade-holder with inner and outer flanged shells.

1,022,926. System and Apparatus for Starting Internal-Combustion Engines. J. C. Boyle, Calgary, Alberta, Can. Includes electrically actuated locks for the intake and exhaust valves.

1,022,935. Apparatus for Handling, Sorting, and Delivering Parcels and the Like. A. W. Gattie, London, and A. G. Seaman, Altrincham, Eng. Electrically operated magnetic transfer rollers are provided at each station and on the conveyor.

1,022,948. Conduit. A. P. Hinsky, assignor to Eastern Flexible Conduit Co., Brooklyn, N. Y. Consists of an inner helically wound tube, an intermediate slotted fiber tube wound in the opposite direction and an outer woven textile covering.

1,022,959. Self-Adjusting Trolley Pole. G. H. Meredith, San Francisco, Cal. Has flexible sections, including a conical socket.

1,022,987. Electric Clock. S. C. Vincent, Baltimore, Md., assignor to Electro-Clock Co. Is actuated by the armature of an electromagnet.

1,022,990. Electric Igniter for Explosive Engines. L. E. Wegner, Nebraska City, Neb., assignor of one-fourth to J. Gilson. Includes a pivoted and weighted electrode engaged by the piston in the cylinder.

1,022,993. Insulator. G. W. Willis, Beckley, W. Va. A coarsely threaded metal shell contains an insulating bushing in which the wire support is imbedded.

1,023,037. Recording System for Railway Signals. T. J. Pyles, Columbia, S. C. Includes recording reels electrically connected to the signal system.

1,023,040. Mine-Signaling Device. J. Rule, Jackson, Cal. A circuit-closer operated by pulling a rod or cord.

1,023,050. Taximeter Control. J. D. Sulsona, assignor to Taximeter Control Co., New York, N. Y. Includes an electric alarm circuit.

1,023,077. Fuse Changer. R. C. Grout, Denver, Colo. A handle with a pair of spring jaws to hold a cartridge fuse.

1,023,085. Folding Chandelier. W. Lumley, assignor to Conneaut Co., Conneaut, O. The stem, arms and joints have wire-receiving openings.

1,023,090. Pneumatic Cleansing Apparatus. A. E. Moorhead, assignor to American Rotary Valve Co., Chicago, Ill. Electrically driven vacuum cleaner.

1,023,092. Electrolytic Rectifier. W. Morrison, Des Moines, Ia. A modification of No. 1,022,695, in which the bismuth anode is alloyed with tellurium.

1,023,102. Circuit-Breaker. C. C. Badeau, assignor to Sears B. Condit, Jr., Boston, Mass. The tripping coil has a U-shaped armature.

1,023,105. Variable-Speed Dynamic Control for Electric Motors. J. D. Firmin, Philadelphia, Pa. Includes a variable-resistance shunt on the field circuit.

1,023,107. Method of Extinguishing Fires in Telephone Installations. C. Gautsch, Berlin, Germany. Consists in separately conducting gases which when mixed produce a solid dust-like salt, and in mixing the gases at a point where the salt will be deposited on the fire.

Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired April 16, 1912.

537,474 and 537,475. Secondary Battery. W. M. McDougall, East Orange, N. J.

537,493. Machine for Securing Filament-Holders into Globes of Incandescent Lamps. A. J. Spiller and J. R. Massey, Cleveland, O.

537,498. Incandescent Electric Lamp. E. Thomson, Swampscott, Mass.

537,499 and 537,500. Electric Measuring Instrument. E. Thomson, Swampscott, Mass.

537,513. Combined Cutout and Lightning Arrester. M. J. Wightman, Scranton, Pa.

535,515. Electric Switch. J. J. Wood, Fort Wayne, Ind.

537,533. Electric Switch. E. M. Hewlett, Schenectady, N. Y.

537,538 and 537,539. Electric Switch. A. Metzger, Schenectady, N. Y.

537,541. Regulator for Dynamo-Electric Machines. W. S. Moody, Lynn, Mass.

537,549. System of Electric Distribution. E. W. Rick, Jr., Swampscott, Mass.

537,555. Filament and Carbon for Electric Lamps. P. Stiens, London, Eng.

537,575. Glass Vessel for Secondary Batteries. H. Kroeker, Berlin, Germany.

537,603. Automatic Telephone-Exchange System. W. Decker, Owego, N. Y.

537,595. Electrical Interrupter. G. J. Anderson, Brooklyn, N. Y.

537,617. Electric Arc Lamp. C. A. Pfluger, Chicago, Ill.

537,626. Electric Railway Conduit System. H. A. Belden, Washington, D. C.

537,630. Electric Railway Conduit System. A. H. Connett, Washington, D. C.

537,633. Electric Arc Lamp. E. H. Crosby, Boston, Mass.

537,644. Telegraphy. R. H. Morris, Roselle, N. J.

537,665. Electric Switch. H. P. Ball, Bridgeport, Conn.

537,672. Electric Railway. J. Claret, and O. Wuilleumier, Lyons, France.

537,673. Electrically Actuated Vehicle. J. B. Clarke, St. Paul, Minn.

537,679. Oil Guard for Electric Fans. P. Diehl, Elizabeth, N. J.

537,693. Process of Evacuating Incandescent Lamps. A. Malignani, Udine, Italy.

537,696. Electric Arc Lamp. L. C. H. Mensing, London, Eng.

537,706. Sectional Conductor for Electric Railways. J. F. McLaughlin, Philadelphia, Pa.

537,715. Safety Support for Overhead Electrical Conductors. A. D. Poole, Boston, Mass.

537,718. Electric Wire Insulator. D. M. Rothenberger, Lancaster, Pa.

537,769. Electric Meter. H. T. Harrison, London, Eng.